ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

FEASIBILITY STUDY

US Army Corps of Engineers
MISSISSIPPI RIVER COMMISSION
New Orleans District

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Appendix A

PROBLEM IDENTIFICATION

A.0.1. This appendix presents detailed technical descriptions which support the Introduction and Problem Identification sections of the main report for the Atchafalaya Basin (Water and Land Resources), Louisiana, feasibility study and for the Atchafalaya Basin project Phase I General Design Memorandum (GDM). Study authorities are quoted verbatim and prior studies and reports are identified and discussed. An array of data, tables, figures, and plates augments the narrative representation of existing conditions, future conditions with and without proposed project features, and problems and needs of the area. Material encompasses physical and biological resources that constitute the environmental setting, characteristics of the people, area economy and development and currently authorized projects. This document also contains information delineating planning objectives and constraints and specific data on analyses and projections.

Section 1 - STUDY AUTHORITY

A.1.1. The Atchafalaya Basin Study is unique because it combines pre-authorization studies of some features with post-authorization studies of others. Authorities for this combined study are presented in the following paragraphs.

A.1.2. The pre-authorization study was authorized by resolutions of the Committees on Public Works of both the US Senate and US House of Representatives. These are as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Chief of Engineers of the United States Army, be, and is hereby requested to examine and review the project for flood control of the Mississippi River in its alluvial valley, and for its improvement from the Head of the Passes to Cape Girardeau, Missouri, as authorized by the Flood Control Act approved May 15, 1928, and as amended by subsequent acts of Congress, including Public Law 780, Eighty-third Congress, which modified the basic project to include a plan of improvement for the control of Old and Atchafalaya Rivers, to determine whether, in the light of changed conditions, any modifications, extensions, or additions to the existing Old River control system or to its operation are warranted at this time." Adopted 11 June 1968.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Chief of Engineers, United States Army, in cooperation with other interested Federal and State agencies, such as the Environmental Protection Agency, and the Louisiana Stream Control Commission, be, and is hereby requested to review the report on the Mississippi River and Tributaries Project, published as House Document Numbered 308, Eighty-eighth Congress, and other pertinent reports, with a view to developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include provisions for reductions of siltation; improvement of water quality; and possible improvements of the area for commercial and sport fishing." Adopted 23 March 1972.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, That the Chief of Engineers of the United States Army, in cooperation with other interested Federal and State agencies, including the Environmental Protection Agency and the Louisiana Stream

Control Commission, is hereby requested to review the report on the Mississippi River and Tributaries Project, published in House Document Numbered 308, 88th Congress, and other pertinent reports, with a view to developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya Basin, Louisiana, which would include provisions for reduction of siltation, improvement of water quality, and possible improvement of the area for commercial and sport fishing." Adopted 14 June 1972.

A.1.3. The post-authorization study or GDM was authorized pursuant to the discretionary authority of the Secretary of the Army acting through the Chief of Engineers by letter dated 18 June 1976, and endorsed by the President of the Mississippi River Commission on 28 June 1976. This authority provided for the study to address, in specific terms, alternate plans to accomplish the authorized purposes of the Atchafalaya Basin Floodway project.

A.1.4. These authorities were addressed in a single study because of the interrelationships among the purposes authorized.

Section 2 - PRIOR STUDIES AND REPORTS

A.2.1. Many studies and reports have been prepared that have specifically affected the Atchafalaya Basin. Those bearing on the results of this study are described in the following paragraphs.

A.2.2. "Flood Control of the Mississippi River in its Alluvial Valley," published as House Document No. 90, 70th Congress, resulted in the authorization, by the Flood Control Act of 1928, of the Mississippi River and Tributaries (MR&T) project. The Atchafalaya Basin Floodway is an original feature of this comprehensive flood control project.

A.2.3. "Flood Control Works in the Alluvial Valley of the Mississippi River," published as House Committee on Flood Control Document No. 1, 74th Congress, resulted in the authorization, under Public Law 678-74, of modification of the MR&T project. Additional features included Morganza and West Atchafalaya Floodways, improvement of the discharge capacity of the Atchafalaya River channel, Wax Lake Outlet, appurtenant works, and provision for purchase of flowage easements in the West Atchafalaya Floodway.

A.2.4. "Comprehensive Flood-Control Plan for Ohio and Lower Mississippi River," published as House Committee on Flood Control Document No. 1, 75th Congress, resulted in authorization, by Public Law 761-75, to purchase easements in the Morganza and Lower Atchafalaya Basin Floodway.

A.2.5. "Flood Control on the Lower Mississippi," published as House Document No. 359, 77th Congress, resulted in authorization, by the Flood Control Act of 18 August 1941, for construction of levees to protect the Tensas-Cocodrie area from Red River backwater flooding. The recommended deauthorization of Boeuf and Eudora Floodways, original features of the MR&T project, was also specified by the 1941 Act.

A.2.6. "Boeuf and Tensas Rivers and Bayou Macon, Arkansas and Louisiana," published as Senate Document No. 151, 78th Congress, resulted in the authorization, by the Flood Control Act of 22 December 1944, of the Tensas Basin, Boeuf and Tensas Rivers, etc., Arkansas and Louisiana, project. The project, as amended, provides flood control and major drainage outlets for 5,300 square miles of southeast Arkansas and northeast Louisiana.

A.2.7. "Plaquemine-Morgan City Route, Intracoastal Waterway, Louisiana," published as Senate Document No. 242, 79th Congress, was a review of reports with a view to modifying the Louisiana-Texas Intracoastal Waterway project to include a Plaquemine-Morgan City route. The recommendations were authorized by the River and Harbor Act of 24 July 1946.

A.2.8. "Flood Control and Drainage on Bayou Lafourche, Louisiana," published as Senate Document No. 191, 79th Congress, resulted in authorization, under the Flood Control Act of 24 July 1946, of improvements to Bayou Lafourche for flood control and drainage purposes. The project was incorporated into the existing Boeuf and Tensas Rivers and Bayou Macon project.

A.2.9. "Ouachita River and Tributaries, Arkansas and Louisiana," published as Senate Document No. 117, 81st Congress, resulted in authorization, by the Flood Control Act of 17 May 1950, to modify the Red River backwater project for the Tensas-Cocodrie area and to incorporate the Jonesville, Louisiana, project into the MR&T project.

A.2.10. "Atchafalaya River, Louisiana," published as Senate Document No. 53, 82nd Congress, recommended construction of a 12- by 125-foot navigation channel for the Atchafalaya River from Morgan City to the Mississippi River via Old River. The report, "Mississippi River and Tributaries with Respect to Old River Control," published as House Document No. 478, 83rd Congress, recommended that the MR&T project be modified to provide for control of flows from the Mississippi River into the Atchafalaya River and basin by mechanically operated control structures at Old River and a navigation lock to permit continued traffic from the Mississippi to the Atchafalaya. These recommendations were authorized by Public Law 780-83, the Flood Control Act of 3 September 1954.

A.2.11. "Boeuf and Tensas Rivers and Bayou Macon, Arkansas, and Louisiana," published as House Document No. 108, 85th Congress, was a review of reports on the project with the same title, with a view to determine whether additional improvements were advisable. The report's recommendations resulted in authorization, by the Flood Control Act of 3 July 1958, of 62 additional miles of channel improvements on seven tributaries of Boeuf River and Bayou Macon. The work was considered a modification of the existing project.

A.2.12. In July 1963, a project plan for the Atchafalaya Floodway was completed and defined in a GDM entitled "Flood Control, Mississippi River and Tributaries, Atchafalaya Basin Floodway, Louisiana." This GDM provided for accelerating the development of a stable central channel by dredging, and by closure of most distributary channels. It also provided for features designed to mitigate for fish and wildlife losses. These latter features were:

- The east and west navigation access channels,
- The east and west freshwater diversion channels,
- Water diversion structures in the east Atchafalaya River levee in the vicinity of Sherburne and in the west Atchafalaya River levee near Courtableau, and

- Provision for access points and boat-launching ramps for recreational purposes.

A.2.13. The objectives of the project plan and the mitigation features are to:

- Stabilize the project flowline to minimize future changes in levee height,

- Reduce overbank siltation,

- Maintain distribution of freshwater to the backswamps, and

- Provide for cross-basin navigation.

A.2.14. The 1963 GDM provided an in-depth engineering evaluation of the ongoing channel enlargement and recommended an ultimate cross-sectional area of 100,000 square feet below the project flowline. The proposal provided for incremental channel enlargement from the existing area to 40,000 square feet, and then successively to 60,000, 80,000, and 100,000 square feet.

A.2.15. "Mississippi River and Tributaries," published as House Document No. 308, 88th Congress, resulted in authorization, under the Flood Control Act of 27 October 1965, for modification of the MR&T project. One feature provides for construction of additional protection levees in the Red River backwater area and a pumping plant in the Tensas area capable of discharging 3,000 cubic feet per second (cfs).

A.2.16. "Morgan City and Vicinity, Louisiana," published as House Document No. 167, 89th Congress, resulted in the authorization, under the Flood Control Act of 27 October 1965, of the Morgan City, Louisiana and Vicinity hurricane protection project. Authorized work provides for construction of new levees, raising of existing levees, and construction of gravity control structures to protect Morgan City, Franklin, and contiguous areas from hurricane-induced flooding.

A.2.17. "Teche-Vermilion Basins, Louisiana," published as House Document No. 524, 89th Congress, resulted in authorization, under the Flood Control Act of 1966, of the Teche-Vermilion Basins, Louisiana, (Water Supply) feature of the MR&T project. The project provides for the diversion of fresh water from the Atchafalaya River by various works during low-flow periods to mitigate water quality and quantity problems caused, in part, by the loss of natural drainage intercepted by the Atchafalaya Basin Floodway levees.

A.2.18. "Atchafalaya River and Bayous Chene, Boeuf, and Black, Louisiana," published as House Document No. 155, 90th Congress, resulted in authorization, under the River and Harbor Act of 1968, of

the project of the same title. The project provides for 20- by 400-foot navigation channels on Bayous Boeuf and Black from the latitude of US Highway 90 to the Gulf Intracoastal Waterway (GIWW), along the GIWW, and along Bayou Chene to the 20-foot contour of the Gulf of Mexico, except that the width in Bayou Boeuf would be reduced to not less than 300 feet where necessary because of industrial developments on both sides of the bayou.

A.2.19. "Eastern Rapides and South-Central Avoyelles Parishes, Louisiana," published as Senate Document No. 113, 91st Congress, resulted in authorization, under the Flood Control Act of 31 December 1970, of the project of the same title. The project is located in Rapides, Avoyelles, St. Landry, and St. Martin Parishes, Louisiana. The plan of improvement provides an outlet for floodflows and drainage from the Chatlin Lake Canal area via Bayou du Lac, Bayou Des Glaises, and the West Atchafalaya Basin Protection Levee borrow pit which ultimately discharges into the Atchafalaya Basin Floodway.

A.2.20. "Bushley Bayou Area of Red River Backwater Area, Louisiana," resulted in authorization, under the Water and Resources Development Act of 1974, of the Bushley Bayou feature of the MR&T project. The project provides for levees and appurtenant works to protect the Bushley Bayou area from backwater flooding.

Section 3 - STUDIES OF OTHERS

A.3.1. A number of studies of the Atchafalaya Basin have been prepared by Federal, state, and local agencies. Studies conducted by the US Fish and Wildlife Service (US FWS) are listed as follows:

- Kennedy, R. S. 1977. Ecological analysis and population estimate of the birds of the Atchafalaya River Basin in Louisiana. Ph. D. dissertation. Louisiana State University, Baton Rouge. 201 pp.

- McClanahan, R. D. 1975. A study of the herbaceous understory vegetation in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 227 pp.

- Huer, E. T., Jr. 1976. Relative abundance of squirrels and rabbits in three forest types of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 50 pp.

- Mermilliod, W. J., III. 1976. Life history and ecology of the large river shrimp, Macrobrachium Ohione (Smith). M.S. Thesis. Louisiana State University, Baton Rouge.

- Horst, J. W. 1976. Aspects of the biology of striped bass, Morone saxatilis (Walbaum), of the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

- Sabins, D. S. 1978. Fish standing crop estimates in the Atchafalaya Basin, Louisiana. Louisiana Cooperative Fishery Research Unit, School of Forestry and Wildlife Management, Louisiana State University, Baton Rouge.

- Hebert, C. E. 1977. A population study of small mammals in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 96 pp.

- Nichols, J. D. 1973. A survey of furbearer resources of the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 184 pp.

- Evans, D. L., Jr. 1976. Relative abundance of deer and woodcock in the three major forest types of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 111 pp.

- Kenikoff, M. 1977. A study of the life history and ecology of the red swamp crawfish, Procambarus Clarkii, in the Lower

Atchafalaya Basin Floodway. Department of Biology, University of Southwestern Louisiana, Lafayette. 81 pp.

• Hyde, K. M. and J. D. Newsom. 1970. A study of a wild turkey population in the Atchafalaya River Basin of Louisiana. Louisiana Cooperative Wildlife Research Unit, Louisiana State University, Baton Rouge. 23 pp.

• Hoese, H. D. 1976. Study of sport and commercial fishes of the Atchafalaya Bay Region. Dept. of Biology, University of Southwestern Louisiana, Lafayette. 52 pp.

• Bryan, C. F., F. N. Truesdale, D. S. Sabins, and C. R. Demas. 1974. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 208 pp.

• Bryan, C. F., F. M. Truesdale, D. S. Sabins. 1975. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 203 pp.

• Bryan, C. F., D. J. Demont, D. S. Sabins, and J. P. Newman, Jr. 1976. A limnological survey of the Atchafalaya Basin. Louisiana Cooperative Fishery Research Unit, Louisiana State University, Baton Rouge. 285 pp.

• Beck, L. T. 1977. Distribution and relative abundance of freshwater macroinvertebrates of the Lower Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 134 pp.

• Binford, M. W. 1977. Crustacean and zooplankton ecology of the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 97 pp.

• Holland, L. E. 1977. Distribution and ecology of plankton rotifera in the Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

• O'Brien, T. P. 1977. Crawfishes of the Atchafalaya Basin, Louisiana with emphasis on those species of commercial importance. M.S. Thesis. Louisiana State University, Baton Rouge. 78 pp.

• Levine, S. J. 1977. Food and feeding habitats of juveniles and adults of selected forage and sport fishes in the Atchafalaya Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge.

• Sager, D. R. 1976. Temporal and spatial distribution of phytoplankton in the Lower Atchafalaya River Basin, Louisiana. M.S. Thesis. Louisiana State University, Baton Rouge. 157 pp.

• Keiser, E. D. 1976. Herpetofaunal survey of the Atchafalaya River Basin, Louisiana. Center for Environmental Studies, Lafayette Natural History Museum, Lafayette. 811 pp.

A.3.2. Numerous reports on the Atchafalaya Basin, issued by the US Environmental Protection Agency, are listed subsequently.

• van Beek, J. L., A. L. Harmon, C. L. Wax and K. M. Wicker. 1979. Operation of the Old River Control Structure, Atchafalaya Basin: An evaluation from a multi-use management standpoint. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-073. 36 pp.

• van Beek, J. L. 1979. Hydraulics of Atchafalaya Basin main channel system: Considerations from a multi-use management standpoint. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-036. 36 pp.

• van Beek, J. L., W. G. Smith, J. W. Smith, and P. Light. 1977. Plan and concepts for multi-use management of the Atchafalaya Basin. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-77-062. 204 pp.

• van Beek, J. L., K. Whicker, and B. Small. 1978. A comparison of three flooding regimes Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-78-106. 79 pp.

• van Beek, J. L. and B. Small. 1977. Survey of cross-basin boat traffic Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-77-090. 28 pp.

• Hern, S. C. and V. W. Lambou. 1979. Pesticides and polychlorinated biphenols in the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-79-061. 80 pp.

• Hern, S. C., W. D. Taylor, L. R. Williams, V. W. Lambou, M. K. Morris, F. A. Morris, J. W. Hilgert. 1978. Distribution and importance of phytoplankton in the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/3-78-001. 194 pp.

• Hern, S. C., V. W. Lambou, and J. R. Butch. 1980. Descriptive water quality for the Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Las Vegas, Nevada. EPA-600/4-80-014. 168 pp.

• Hern, S. C. and V. W. Lambou. 1978. Productivity responses to changes in hydrological regimes in the Atchafalaya Basin, Louisiana. Proceedings of the International Symposium on Environmental Effects of Hydraulic Engineering Works, Knoxville, Tennessee. Sept. 1978. 9 pp.

• Gagliano, S. M. and J. L. van Beek. 1975. Environmental base and management study Atchafalaya Basin, Louisiana. US Environmental Protection Agency, Office of Research and Development, Washington, D.C. EPA-600/5-75-006. 220 pp.

A.3.3. Other studies conducted are as follows:

• Soileau, L. D., K. C. Smith, R. Hunter, C. E. Knight, D. M. Soileau, W. E. Shell, Jr., and D. W. Hayne. 1975. Atchafalaya Basin usage study (a cooperative study conducted by the Louisiana Wildlife and Fisheries Commission and the US Army Corps of Engineers, New Orleans District). US Army Corps of Engineers, New Orleans District, New Orleans, Louisiana. 85 pp.

• Bell, F. W. 1981. Recreational benefits from the Atchafalaya River Basin (a joint study sponsored by the US Fish and Wildlife Service and the US Army Corps of Engineers, New Orleans District). Report on contract 14-16-009-80-009. Dept. of Economics, Florida State University, Tallahassee. 227 pp.

• Bell, F. W. 1981. Commercial fishing and trapping: An economic analysis of the Atchafalaya River Basin (a joint study sponsored by the US Fish and Wildlife Service and the US Army Corps of Engineers, New Orleans District). Report on contract 14-16-009-80-009. Dept. of Economics, Florida State University, Tallahassee. 294 pp.

Section 4 - HISTORY AND STATUS OF PLANS AND IMPROVEMENTS

History of Atchafalaya River Development

EARLY HISTORY

A.4.1. Reconstructions based on geologic evidence show that conditions for the formation of the Atchafalaya distributary were established during the 1500's. According to Elliott (1932), a map dated 1578 drawn by Monk Ptolemy, who accompanied DeSoto's expedition in 1542, shows conclusively that the Atchafalaya River then, as now, served as an outlet for the Mississippi River. Accounts of later visitors to the Atchafalaya Basin reflect its impassability. Highly cultivated and well-populated communities quickly developed on the alluvial ridges of Bayous Teche and Lafourche, which flanked the region; but no overland trails of any consequence crossed the basin as only water transportation was feasible. The most traveled route across the basin was by way of Bayou Plaquemine, through Upper Grand River and Bayou Courtableau to Bayou Teche at Opelousas. The Atchafalaya River itself was a minor stream because flow was restricted by a massive raft of logs at the upper end. The river was joined near the present end of its leveed segment by Bayou Courtableau and flowed diagonally across the basin along the modern Upper Grand River. At its junction with Bayou Plaquemine, the Atchafalaya River flowed south along what is now Lower Grand River and emptied into the lake area north of Berwick Bay. Darby's map of Louisiana from "A Geographical Description of the State of Louisiana, 1816" shows this relationship (see Plate A-1) and refers to the entire stream as the Atchafalaya. South of the cross-basin portion now represented by Upper Grand River, Darby shows only minor dendritic drainage into a very large Grand Lake, which he called Lake Chetimaches. The overall accuracy of this map is too impressive to suspect the cartographer of serious error; therefore, it is fairly certain that only since Darby's time has a channel of considerable size developed that carries water to the head of Grand Lake.

RAFT OF LOGS

A.4.2. In the area currently known as Turnbull Island near the turn of the 19th century, the meandering course of the Mississippi River

was such that the Red River flowed into the upper end of the bend. The Atchafalaya River was a distributary at the lower side of the bend and served as a great drift chute for both the Red and Mississippi Rivers.

A.4.3. The chute was choked by a mass drift, known as "the raft," which began to form about 1778 and continued to grow until 1831 when Shreve's cutoff isolated the bend in the Mississippi River. Efforts to remove "the raft" were commenced in 1839 and continued until 1855 when the obstruction was finally cleared.

DEVELOPMENT OF OLD RIVER

A.4.4. A map drawn in 1839, eight years following Shreve's cutoff, depicts rapid silting of the lower arm of Old River near its junction with the Mississippi River. No doubt, some narrowing of the abandoned channel and a great deal of shoaling also took place. By 1854-55, sizable bars had formed at the Red River's junction with the upper arm of Old River, but it was essentially open the entire distance to the Mississippi River. The lower arm, on the other hand, was closed at the point of cutoff, and a canal through the silted area was proposed by the Louisiana State Engineer. Morever, the Mississippi River had meandered considerably to the south from the original point of cutoff, so that the oxbow lake formed by Old River was almost isolated and a sharp entrance angle existed between the waters of the Red River flowing through Upper Old River and the Mississippi.

A.4.5. The Lower Old River was described as a wide, shallow, slack-water basin, receiving sediment alternately from the Mississippi and Red Rivers. By 1875 this process had nearly closed the low-water connection; and the waterway near the lower end of Turnbull's Island was only about 100 feet wide and 20 inches deep, with a fall of about 2 feet for a quarter of a mile toward the Atchafalaya. Only by extensive dredging performed by the State of Louisiana to remove a bar that formed yearly at the head of Lower Old River could a channel between the Atchafalaya and the Mississippi Rivers be maintained.

A.4.6. As the size of the Atchafalaya channel increased (due in part to raft clearance), additional amounts of Red River water were diverted down the Atchafalaya so that by 1883, considerable silting occurred in both the upper and lower arms of Old River. Had no dredging been done, the Red River (using the Atchafalaya channel) and the Mississippi River probably would have flowed in separate channels to the sea.

A.4.7. In 1891, a sill and dam were built across the old Mississippi River channel just south of the former junction of the Red and Mississippi Rivers. The purpose of the dam was to force the Red

River, when below a certain low stage, to discharge its flow through Upper Old River into the Mississippi River. The dam was sporadically maintained and finally abandoned in 1896, after which the upper arm of Old River silted up entirely. Only a series of elongated lowlands now marks its former course.

A.4.8. By 1940, dredging to maintain a channel through Lower Old River was a thing of the past as rapid natural enlargement of the channel had begun. Formerly (1882-1942), water flowed from Old River into the Mississippi River an average of 50 days of every year; but this reverse flow was recorded only 9 days between 1942 and 1950.

A.4.9. Carr Point cutoff, dredged in 1944-45, provided a shorter path for Mississippi River water diverted into Lower Old River. Shortly after this cutoff was made, the northern span of an abandoned railroad bridge, which crossed Old River about 2 miles west of its entrance into the Mississippi, fell into the rapidly enlarging river. In 1949 and 1950, revetments were placed on the Mississippi River banks upstream and downstream from Old River as the Mississippi began a rapid westward migration.

LEVEE CONSTRUCTION

A.4.10. By 1881, levees had been built by private interests along the Atchafalaya River from Simmesport downstream 26 miles on the west bank and to approximately half that distance on the east bank. In that year, levees were also built on the south side of Bayou des Glaises and Old River to channel floodwaters down the river rather than through the lowlands flanking the river. These levees were subject to general crevassing during the 1882 high water, when a discharge of 281,000 cfs is reported to have gone down the Atchafalaya. Between 1882 and 1900, levees were enlarged and extended downstream. By 1900, they flanked both sides of the river as far south as Melville, and by 1910 had been extended to Krotz Springs. Engineering data show that a rapid increase in river depth and cross-sectional area accompanied each extension of the levees.

SILL DAMS NEAR SIMMESPORT

A.4.11. By 1882, the Atchafalaya River had enlarged to such an extent that attempts were made to control its flow with brush and stone sill dams. Two dams were built just below the normal low water elevation to restrict the Atchafalaya River flow to a volume equal to the flood discharge of Red River. One was completed in 1888 in the vicinity of the present highway and railroad bridge at Simmesport; the other, completed in 1889, was approximately one-half mile downstream. These

dams were maintained until 1920, after which partial maintenance was carried on by the Louisiana Railway and Navigation Company in connection with construction of a bridge across the river in this locality. Maintenance was completely discontinued after 1934 and the dams deteriorated. Remnants of the sills that obstructed the channel were removed in 1939-40 during the dredging operations described subsequently.

DREDGING

A.4.12. Subsequent to the passage of the Flood Control Act of 1928, a program of dredging was begun in 1932 to improve the discharge capacity of the Atchafalaya River. A principal deterrent to enlargement was the tortuous maze of deltaic channels into which the river branched south of its leveed segment. Between 1932 and 1940, a single channel was dredged through this area with an overall 250-foot bottom width and a depth of 40 feet below National Geodetic Vertical Datum (NGVD).[1/] More than 100,000,000 cubic yards of earth were dredged from this portion of the river.

A.4.13. In 1938, dredging was begun in the upper, leveed segment of the Atchafalaya River, and the entrance angle at the junction of the Old, Red, and Atchafalaya Rivers was improved. The channel was enlarged at the railroad bridges that crossed the river at Simmesport, Melville, and Krotz Springs, and to a minor extent in other parts of the leveed channel. Wax Lake Outlet, a channel 15 miles long, 300 feet wide, and having a depth of 45 feet below NGVD, was completed in 1941. It provided an additional outlet for flow through the marshes south of the basin to the gulf.

A.4.14. In 1954, a systematic program was begun to accelerate maturation of the Atchafalaya River to its estimated ultimate size of 100,000 square feet in cross-sectional area. This program involved progressively increasing the confinement of ordinary flows to the main river channel, as well as dredging to increase the river cross-section to accommodate an increased flow. Results of this program closed 22 distributary streams and also increased confinement of flow by the placement of dredged material intermittently along the river banks.

[1/] Unless noted otherwise, all elevations are in fact referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level.

No work has been done under this program since 1968, when work was suspended because the limited funds available had to be used for raising levees. In 1971, the Corps of Engineers agreed with the National Wildlife Federation to continue the suspension until an environmental impact statement had been filed. Today, under the influence of the work done between 1954 and 1968, the channel cross-section has grown to 118,000 square feet at certain locations. Between miles 54 and 100, the average cross-section is between 80,000 and 90,000 square feet. Below mile 100, where little confinement had been achieved when the program was suspended, the average channel area is only about 38,000 square feet.

The Atchafalaya Basin Floodway Project

OVERVIEW

A.4.15. Any discussion of the existing features, plans and improvements associated with the Atchafalaya Basin Floodway project must begin with the Flood Control Act of 1928, as amended. As a result of the flood which devastated the lower Mississispi River Valley in 1927, this Act authorized the comprehensive MR&T flood control project to provide flood protection in the alluvial valley of the Mississippi River between Cape Girardeau, Missouri, and Head of Passes, Louisiana. Presently, the MR&T project includes levees along the main stem of the river and its tributaries in the alluvial plain to confine floodflows; reservoirs on the tributaries to store excess floodflows; floodways and improvements to increase channel capacity, such as revetments, dikes, and dredging; and facilities, such as control structures, cutoffs, pumping plants, floodwalls, and floodgates. These features are designed to convey the project design flood discharges shown in Figure A-4-1. As can be seen by examination of the figure, the principal role of the Atchafalaya Basin Floodway System in the MR&T flood control project is to convey one half of the project design flood of 3,000,000 cfs, or 1,500,000 cfs, to the Gulf of Mexico.

A.4.16. In its early stages of development the Atchafalaya River traversed the basin via numerous small shallow channels, bayous and lakes as this natural lowland had no confining levees and only one outlet, the Lower Atchafalaya River below Morgan City. However, beginning in 1928, a series of significant modifications to the features of the basin, summarized in Tables A-4-1 and A-4-2, have been authorized by congressional action.

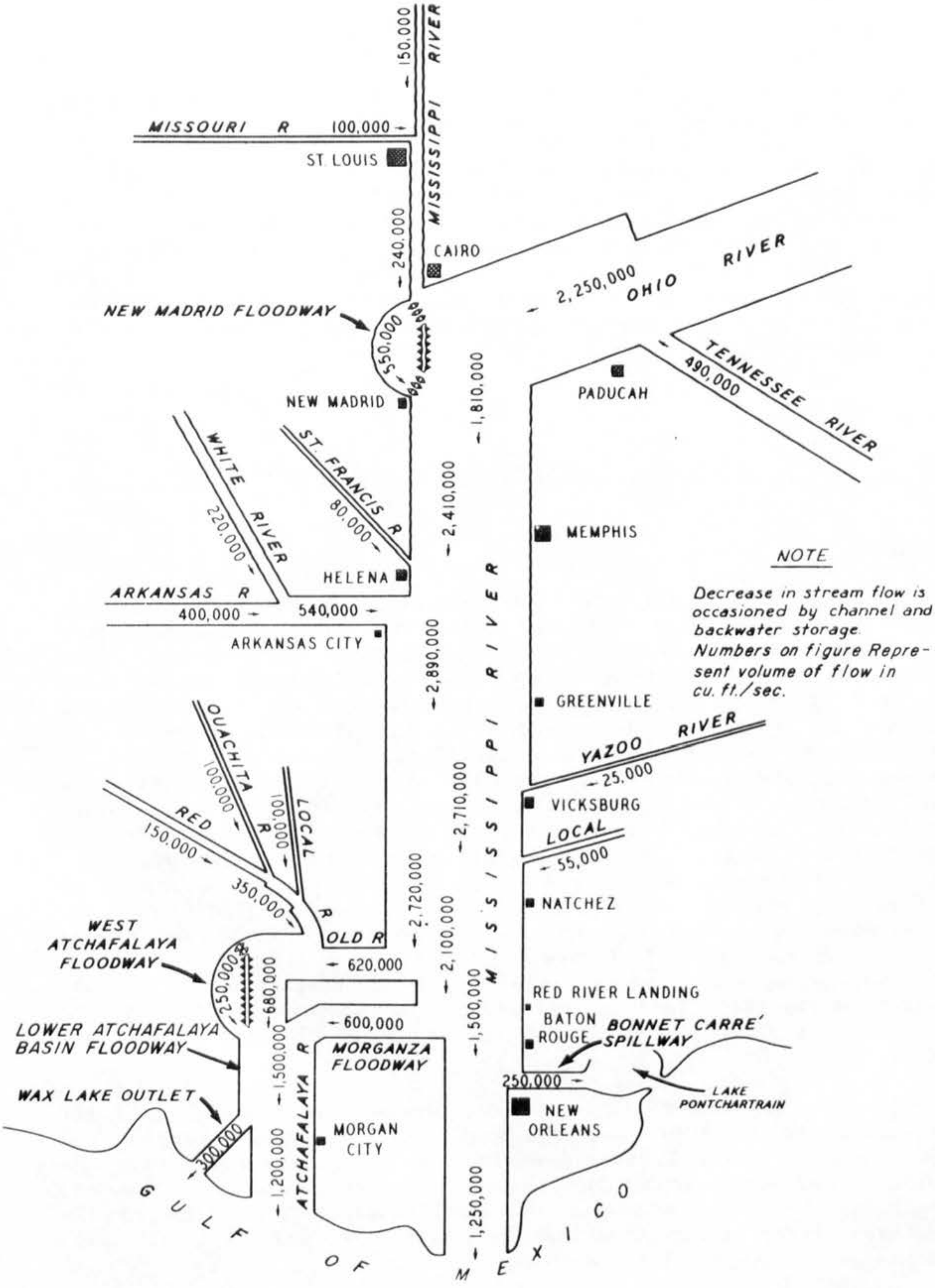

FIGURE A-4-1 PROJECT DESIGN FLOOD

TABLE A-4-1

OLD RIVER PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act of 1928 (PL 391/70)	(None)	Section 10 of the Act directs Secretary of War, through the Corps of Engineers, US Army, "to prepare and submit to Congress at the earliest practicable date projects for flood control on all tributary streams of the Mississippi River System subject to destructive floods which projects shall include:..Old River."
FC Act of 1941 (PL 288/77)	(HD 359/77/1)	Provides that the cost of right-of-way and flowage easements required for future setbacks of main-line Mississippi River levees shall be a Federal responsibility. (Confirmed by FC Act of 1944, PL 534-78). Separates maintenance requirements from construction and provides that future maintenance expenditures shall not reduce authorizations.
FC Act of 1954 (PL 780/83)	(HD 478/83/2)	Modified the Act of 15 May 1928, to include control of Old and Atchafalaya Rivers and a lock for navigation substantially as set forth in Section XIII of the MRC report, dated 2 February 1954.

TABLE A-4-1 (Continued)

OLD RIVER PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act of 1958 (PL 85/500)	(None)	Modified the Act of 15 May 1928 to include in addition to the previous authorization the sum of $28,200,000 for prosecution of the plan of improvement for the control of Old and Atchafalaya Rivers and a navigation lock approved in the Act of 3 September 1954.

HD = House Document
PL = Public Law

TABLE A-4-2

ATCHAFALAYA BASIN PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act 1928 (PL 391/70)	(HD 90/70/1)	Atchafalaya Floodway
FC Act 1928 (PL 391/70)	(CD 28/70/2)	R/W related to Bayou des Glaises setback
FC Act 1928 (PL 391/70)	(CD 28/70/2)	Atchafalaya River levee, revetment, and R/W
FC Act 1928 (PL 391/70)	(CD 28/70/2)	R/W, Atchafalaya Floodway levees
FC Act 1928 (PL 391/70)	(CD 28/70/2)	Ring levees and R/W at Simmesport, Melville, and Morgan City
FC Act 1928 (PL 391/70)	(HD 308/88/2)	Addition to ring levees
FC Act 1934 (PL 171/73)	(HR 8018)	R/W for levees
FC Act 1936 (PL 678/74)	(CD 1/71/1)	Morganza Floodway; raise in grade, Pointe Coupee levee; Atchafalaya River and Basin Improvement; Wax Lake Outlet and Charenton Canal; provide for drainage intercepted by floodway levees; roads on levees; flowage easements above Krotz Springs.
FC Act 1938 (PL 761/75)	(CD 1/75/1)	Morganza Flowage Easements
FC Act 1941 (PL 228/77)	(HD 359/77/1)	Flexibility in monetary authorization. Separates maintenance requirements from construction and provides that future maintenance expenditures shall not reduce authorizations.

TABLE A-4-2 (Continued)

ATCHAFALAYA BASIN PROJECT AUTHORIZATIONS

Act and Law	Document	Feature
FC Act 1946 (PL 526/79)	(HD 378/74/2)	Incorporate Bayou des Glaises ditch in MR&T
FC Act 1946 (PL 526/79)	(None)	Part of $100 million for increased costs
FC Act 1954 (PL 780/83)	(None)	Part of $200 million for increased costs
FC Act 1954 (PL 780/83)	(SD 53/82)	Atchafalaya River navigation
FC Act 1962 (PL 874/87)	(None)	Flexibility in monetary authorization

CD = Congressional Document
HD = House Document
PL = Public Law
SD = Senate Document

A.4.17. As it exists today, the Atchafalaya Basin Floodway is comprised of a combination of natural characteristics and man-made elements. Project features are described in the following paragraphs and address the floodway, flood control and drainage works, and major navigation projects within the study area. The Old River control complex is not a specific feature of this project, but has been included because of its significance to and impacts on the Atchafalaya Basin Floodway.

Principal Project Features

OLD RIVER CONTROL COMPLEX

A.4.18. Flows from the Old River control complex, together with flows from Red River, form the head of the Atchafalaya River. Historically, Old River was a 7-mile stream connecting the Mississippi River with the Red and Atchafalaya Rivers. Changing conditions in Old River have been observed for the better part of a century. In 1950, a major definitive study ("The Atchafalaya River Study," published in three volumes, dated May 1951) was begun under the direction of the Mississippi River Commission to determine the possibility of the Mississippi River changing its course. The study concluded that, in the absence of man's intervention, the Mississippi River would shift to the Atchafalaya River channel through Old River, selecting this shorter course to the gulf, and that afterwards, the present lower Mississippi River would become a deep estuary cut off from freshwater flow except during major floods. As a result, the Old River project was authorized by the Flood Control Act of 1954, Public Law 780, 83rd Congress, 2nd Session, Chapter 1264, House Resolution 9859, approved 3 September 1954.

A.4.19. The primary purpose of the Old River control complex is to prevent the Mississippi River from changing its course to the Atchafalaya River. The complex controls the amount of flow from the Mississippi River into the Atchafalaya River and basin, based on 1950 conditions. Principal features of the plan consist of two mechanically-operated control structures located on the right descending bank of the Mississippi River between miles 314 and 315 above Head of Passes; an inflow channel from the Mississippi River to the low sill control structure; an outflow channel connecting the low sill control structure with Red River at about mile 10.5 above its mouth; a lock for navigation connecting the Mississippi River and the Atchafalaya and Red Rivers; forebay and tailbay channels for the lock; an earthen dam closing Old River; enlargement and extension of mainline Mississippi River levees from Shaw to Torras; and bank stabilization as required for the Old River inflow and outflow channels and for the

Red and Atchafalaya Rivers between the outflow channel and the vicinity of Simmesport. The two control structures, designated the low sill structure and the overbank structure, are intended to pass a maximum controlled discharge of 620,000 cfs at project flood conditions. To insure that capability, they were designed with a minimum capacity of 700,000 cfs at project flood conditions. Present maximum combined capacity of the structure is 850,000 cfs because of changes in headwater and tailwater conditions.

ATCHAFALAYA RIVER

A.4.20. The Atchafalaya River is the largest distributary of the Mississippi River and is the only natural intake of the Atchafalaya Basin Floodway System. The Atchafalaya River extends from its source at the junction with Old River and the Red River to Atchafalaya Bay at the Gulf of Mexico and is comprised of an upper leveed section, a middle unleveed section and a lower outlet section. The intake capacity of the Atchafalaya River presently exceeds 700,000 cfs. Through approximately the upper half of the floodway, the Atchafalaya River is confined between levees which serve to protect the lands of the Morganza and West Atchafalaya Floodways when these floodways are not in operation. On the west bank, the towns of Simmesport, Melville, and Krotz Springs are protected on the floodway side of the perimeter levees by ring levees that connect to the river levee.

WEST ATCHAFALAYA FLOODWAY

A.4.21. The West Atchafalaya Floodway (the west side intake for the Lower Atchafalaya Basin Floodway) covers an area of about 170,000 acres. This intake is bounded on the north by the Bayou des Glaises fuseplug levee, on the west by the West Atchafalaya Basin Protection Levee, and on the east by the west bank Atchafalaya River levee. The lower limit of the West Atchafalaya Floodway is approximately at the latitude of Krotz Springs. The design capacity of the West Atchafalaya Floodway is 250,000 cfs above Bayou Current and 400,000 cfs below Bayou Current.

MORGANZA FLOODWAY

A.4.22. The Morganza Floodway is the east side intake for the Lower Atchafalaya Basin Floodway and encompasses an area of 68,000 acres. Across the head of the Morganza Floodway is a massive, gated control structure almost 3/4 mile long. It is bounded on the east by the Morganza Floodway lower guide levee, which extends southwesterly from

the west bank of the Mississippi River levee near Morganza to a junction with the East Atchafalaya Basin Protection Levee at the latitude of Krotz Springs. On the north and west, it is bounded by the Morganza Floodway upper guide levee, which extends southwesterly from the west bank Mississippi River levee to a junction with the east Atchafalaya River levee near Red Cross and from there by the east Atchafalaya River levee to the latitude of Krotz Springs. Design capacity for the Morganza Floodway is 600,000 cfs.

LOWER ATCHAFALAYA BASIN FLOODWAY

A.4.23. The Lower Atchafalaya Basin Floodway covers an area about 14 miles wide by 65 miles long and extends from the latitude of Krotz Springs to the approximate latitude of Morgan City. It is bounded on the east by the East Atchafalaya Basin Protection Levee and on the west by the West Atchafalaya Basin Protection Levee. The East Atchafalaya Basin Protection Levee emanates from its intersection with the Morganza Floodway lower guide levee near Lottie and continues generally southward through Morgan City and along the Lower Atchafalaya River to Avoca Island Cutoff. The West Atchafalaya Basin Protection Levee originates near Hamburg, at its junction with the Bayou des Glaises fuseplug levee and proceeds in a southerly direction to a point south of Berwick.

LOWER ATCHAFALAYA RIVER

A.4.24. The Lower Atchafalaya River has a design capacity of 1,200,000 cfs and is the natural outlet to the Gulf of Mexico for the Atchafalaya Basin. It becomes the outlet just below Morgan City at the confluence of Berwick Bay, Bayou Shaffer and the GIWW and flows southward to Atchafalaya Bay, an approximate distance of 20 miles.

WAX LAKE OUTLET

A.4.25. The Wax Lake Outlet was constructed to improve the capability of the features of the Atchafalalya Basin project to pass floodflows to the Gulf of Mexico. This dredged channel, located about 10 miles west of Berwick, extends from Sixmile Lake through the Teche Ridge and Wax Lake into Atchafalaya Bay, a distance of about 16 miles. The channel is constructed to a bottom width of 300 feet from Sixmile Lake to a point 0.5 mile below Bayou Teche and to a bottom width of 400 feet beyond that point. It has a uniform depth of 45 feet below NGVD and a design capacity of 300,000 cfs.

Present Operation

INTAKE FLOWS

A.4.26. Flows enter the Atchafalaya Basin Floodway System through the Atchafalaya River, the Morganza Floodway and the West Atchafalaya Floodway. The actual source is dependent on the total amount of flow passing the latitude of Old River in both the Mississipi and Red Rivers. Latitude flows are distributed to the Atchafalaya and Mississippi Rivers by regulation of the Old River control complex. When the sum of the flows in the Mississippi and Red Rivers is less than 2,100,000 cfs, the structure is operated to maintain a ratio of 70 percent down the Mississippi River and 30 percent down the Atchafalaya River. The 70/30-percent flow distribution is based on the natural flow distribution that occurred in Lower Old River in 1950, and was specified in the project authorization document as the basis for the flow distribution for the Old River control complex. When the latitude flow exceeds 2,100,000 cfs, and assuming the 70/30-percent distribution, the flow in the Mississippi River below the Old River complex will approach 1,500,000 cfs, an excess of which requires the operation of the Morganza control structure and the Morganza Floodway. As latitude flow approaches 2,800,000 cfs, the design capacity of the Atchafalaya River intake (680,000 cfs) and the Morganza intake (600,000 cfs) will be attained and the West Atchafalaya Floodway may be pressed into service. However, the actual capacity of the Atchafalaya River, presently in excess of 700,000 cfs, would be utilized prior to operating the West Atchafalaya Floodway.

FLOWS WITHIN THE FLOODWAY

A.4.27. As previously stated, above the latitude of Krotz Springs, floodway flows may be conveyed in three separate conduits (Atchafalaya River, West Atchafalaya Floodway, and Morganza Floodway). These conduits are basically adequate in capacity for the design flows; however, some of the guide levees still need to be raised. Normal flows are handled entirely by the Atchafalaya River which, in this reach, generally has a leveed main channel with a cross-sectional area in excess of 100,000 square feet. The West Atchafalaya and Morganza Floodways, on the other hand, do not have a defined conveyance channel, but rather consist of wide sheet flow conduits over natural ground. Below the latitude of Krotz Springs, the three separate conduits merge into a single floodway known as the Lower Atchafalaya Basin Floodway. In this lower portion of the floodway system, the Atchafalaya River does not have a well-developed, leveed main channel. Consequently, for flows greater than 250,000 cfs, significant overbank flooding occurs below the latitude of

Krotz Springs. Due to the problems of overbank siltation and the status of levee construction in this portion of the floodway, the actual capacity is substantially lower than the floodway design capacity of 1,500,000 cfs. Additional channel enlargement and/or levee raising are required to develop the full potential of the floodway to safely pass its share of the project design flood.

OUTLET FLOWS

A.4.28. Flows conveyed through the Lower Atchafalaya Basin Floodway exit through two outlets: the Lower Atchafalaya River, the natural outlet, and Wax Lake Outlet, a man-made outlet constructed in 1942. The design conveyance capacities are 1,200,000 cfs for the Lower Atchafalaya River and 300,000 cfs for the Wax Lake Outlet. However, the actual combined capacity of the two outlets is currently only about 850,000 cfs.

Detailed Project Description

A.4.29. A detailed description of improvements associated with the Old River control complex and the Atchafalaya Basin Floodway system is provided in the following paragraphs.

OLD RIVER CONTROL COMPLEX

A.4.30. General. The principal features of the Old River control complex are the low sill structure, overbank structure, navigation lock and appurtenant channels, closures, levees, and revetments.

A.4.31. Low Sill Structure. The low sill structure is constructed of reinforced concrete and has fabricated steel control gates, an inflow channel from the Mississippi River, and an outflow channel to the Red River. The structure, built on steel piles, has a length of 566 feet between abutments and 11 gate bays, each having a 44-foot clear span between piers. The three center bays (low-flow bays) have weir crests at elevation minus 5 feet NGVD and the four outer bays on each side of the center bays have weir crests at elevation 10.0. The bays are operated by the use of vertical lift steel gates, which are opened and closed by two gantry cranes. The structure supports a 26-foot-wide highway bridge. Work was completed in 1959 and operation commenced in 1960.

A.4.32. Overbank Structure. The structure is a controlled spillway constructed of reinforced concrete with hinged timber panels for control of flows. It has a length of 3,356 feet between abutments and consists of 73 bays, each with a 44-foot clear opening between 2-foot thick piers. The crest of the concrete spillway weir is at elevation 52 feet NGVD. Fifteen timber panels, each of which is 2 feet 10.5 inches wide, are provided in each bay. The panels are hinged at the top and are raised and lowered by two gantry cranes. Construction of the overbank structure was completed in October 1959.

A.4.33. Inflow Channel - Low Sill Structure. The channel, as constructed, is 1,000 feet wide with an invert elevation of minus 5 feet NGVD and 1 vertical (V) on 4 horizontal (H) side slopes. It extends from the Mississippi River to within about 600 feet of the structure where the bottom width begins a transition to a width of 566 feet at the structure. An impervious clay blanket and riprap protection of varying thickness have been provided on the channel bottom upstream of the concrete apron. Riprap 18 inches thick has been provided on the side slopes up to elevation 48 feet NGVD for a total distance of about 600 feet upstream. This slope protection holds the alinement of and prevents meander of the approach channel. Reinforced concrete wingwalls have been provided at each corner of the structure. The inflow channel was completed in 1960.

A.4.34. Outflow Channel - Low Sill Structure. The outflow channel, as constructed, has a variable section to provide a transition from the stilling basin of the low sill structure to the design outflow channel section. The design section has a bottom width of 900 feet, 1V on 4H side slopes, and an invert elevation sloping from minus 8 feet NGVD near the structure to minus 10 feet NGVD at the junction of the outflow channel with the Red River. The bottom of the channel is protected by derrick stone and riprap for 260 feet downstream from the stilling basin. The side slopes of the channel are protected by riprap for 630 feet downstream of the end of the stilling basin. Sections of the channel in areas of readily erodible soils were dredged to pilot cross-section. The outflow channel was also completed in 1960.

A.4.35. Navigation Lock. The Old River navigation lock consists of reinforced concrete U-frame type construction, providing a usable chamber 75 feet wide by 1,200 feet long. The gates are of the horizontally framed, miter type, designed for a maximum lift of 37 feet. Filling and emptying the chamber is accomplished by means of 13-foot 6-inch square longitudinal culverts with side ports in the upper approach monolith and lock chamber and a bottom lateral discharge system in the lower approach monolith. Flow is controlled by means of individually operated segmental valves of the reversed tainter type. The Old River navigation lock was completed in 1962 and placed in operation in 1963.

A.4.36. Navigation Channel. Inflow and outflow channels for the navigation lock were completed and placed in operation in 1963. The inflow channel for the lock is approximately 2,400 feet long, 300 feet wide, and has a depth of minus 11 feet NGVD. The outflow channel is approximately 7,000 feet long, 500 feet wide, and has a depth of minus 11 feet NGVD.

A.4.37. Old River Closure. The closure dam consists of an earthen embankment constructed of sand obtained from the riverbed and of clay and silty soils obtained from an adjacent borrow area. The top of the dam is at elevation 68 feet NGVD. Its height ranges from approximately 20 feet near the bank where it connects with the levees to approximately 99 feet at the deepest part of the stream. The closure is about 1,450 feet long and has a crown width of 60 feet. Side slopes from the top of the dam down to about elevation 37 feet NGVD are 1V on 4H. Below elevation 37 feet NGVD, side slopes are 1V on 20H for about 500 feet from the centerline, then approximately 1V on 6H down to the bottom of the river. The Old River closure was completed in 1963.

A.4.38. Levees. The levees have a 10-foot crown, a net riverside slope of 1V on 4H and a net landside slope of 1V on 5.5H for net heights under 25 feet and 1V on 6H for net heights of 25 feet or more. The levee is constructed to a net grade of elevation 70 feet NGVD at Black Hawk, and generally slopes to elevation 64.2 feet NGVD at the point where it connects with the levee along the south bank of Lower Old River. Construction of levees is complete. Additional levee construction will be required in connection with the planned auxiliary structure.

A.4.39. Revetment. Stone and articulated concrete revetments are being constructed as required in the inflow and outflow channels of the control structures and along the Red and Atchafalaya Rivers between the outflow channel of the low sill structure and the vicinity of Simmesport to control meandering of the main channels as a result of construction of the control structures. These works are surveyed periodically to assure that they are in place and that repairs are made as required. Additional revetment work will be required in connection with the construction of the auxiliary structure.

A.4.40. Auxiliary Structure. The construction of an auxiliary control structure to supplement the existing low sill structure began in July 1981 and is scheduled for completion in late 1985. As presently designed, the auxiliary structure is of reinforced concrete and has six 62-foot-wide gate bays with a sill elevation of minus 5.0 feet NGVD with steel tainter-type gates for control. About 15,000 feet of conveyance channel and 22,000 feet of levee will be constructed. The need for an auxiliary structure is discussed in Section 7 of this appendix.

ATCHAFALAYA BASIN FLOODWAY SYSTEM

A.4.41. The Atchafalaya Basin Floodway system, exclusive of Old River control complex, is shown in Plate A-2. The project features associated with the floodway system are listed in Table A-4-3 and are described in subsequent paragraphs of this section.

ATCHAFALAYA BASIN FLOODWAY SYSTEM LEVEES

A.4.42. General. The Atchafalaya Basin Floodway system has 449.2 miles of levee, 213.1 miles of which have been found to be deficient after the project flowline was adjusted upward after the 1973 flood. Major deficiencies are on the East and West Atchafalaya Basin Protection Levees. Much of the levee system west of Berwick, which provides protection from backwater flooding, is also deficient, although to a lesser degree than the protection levees. The East Atchafalaya Basin Protection Levee, from a point about 7 miles below the Morganza control structure (on the Morganza Floodway lower guide levee) to the end of the Avoca Island levee, and the West Atchafalaya Basin Protection Levee, from US Highway 190 to its end below Berwick, are considered deficient with respect to the new flowline. Minor deficiencies also exist on the Mansura Hills to Hamburg levee and the west Atchafalaya River levee. Planning, design, and construction to upgrade the levees to required standards is underway. Overall completion is scheduled for 1997.

A.4.43. The description and total length of the levees and floodwalls in the system are shown in Table A-4-4.

A.4.44. The Morganza Floodway Levees. These levees consist of the upper and lower guide levees which, with the east Atchafalaya River levee, form a floodway averaging about 5 miles wide. The upper guide levee extends 8.9 miles southwesterly from the combined control structure to the east Atchafalaya River levee about 2 miles upstream from Melville. This levee protects more than 100 square miles of farmlands in upper Pointe Coupee Parish from overflow during floodway operations. The lower guide levee extends about 19.5 miles in a southerly direction from the control structure to join the East Atchafalaya Basin Protection Levee at the latitude of Krotz Springs. The levees are maintained by local interests. Maintenance includes mowing and inspection for caving and loss of cross-section. The upper guide levee is complete, whereas the lower guide levee requires improvement to provide adequate protection against a project design flood.

A.4.45. The East Atchafalaya Basin Protection Levee. The East Atchafalaya Basin Protection Levee begins at the lower end of the lower guide levee of the Morganza Floodway and extends southward

TABLE A-4-3

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	LEVEES AND FLOODWALLS
1	Morganza Floodway guide levees
2	East Atchafalaya Basin Protection Levee
3	West Atchafalaya Basin Protection Levee
4	Atchafalaya River levees
5	Bayou des Glaises fuseplug levee
6	Mansura Hills to Hamburg levee
7	Levees west of Berwick
	FLOOD CONTROL STRUCTURES
8	Morganza combined control structure
	NAVIGATION WORKS
9	Atchafalaya River channel
10	Bayou Sorrel lock
11	Charenton floodgate and bridge
12	Calumet floodgates (2)
13	Berwick lock
14	Bayou Boeuf lock
15	Rerouting GIWW below Morgan City
16	East access channel
17	West access channel
	CHANNEL IMPROVEMENT
18	Enlargement dredging (mile 0 to mile 54)
19	Distributary closures
20	Enlargement dredging (mile 54.5 to mile 112.3)
21	Revetments
	DRAINAGE IMPROVEMENTS (POINTE COUPEE)
44	Enlargement of Bayou Latenache
45	Enlargement of Morganza upper guide levee borrow pit
46	Pointe Coupee drainage structure
	Pointe Coupee pumping station
	OTHER DRAINAGE
47	Drainage improvements west of Berwick
48	Wax Lake Outlet
49	Lower Atchafalaya River
	IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION
50	Dredge material retaining dikes
51	Roads on levees
52	Public Use areas

TABLE A-4-3 (Continued)

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION (Continued)
16	East access channel
17	West access channel
53	East freshwater distribution channel
54	West freshwater distribution channel
55	East freshwater distribution structure
56	West freshwater distribution structure
	FLOWAGE EASEMENTS
57	Below Krotz Springs
58	West Atchafalaya Floodway
59	Morganza Floodway
60	Morgan City front
61	Bayou des Glaises loop
62	Bayou Chene
	DRAINAGE IMPROVEMENTS (WABPL)
22	Bordelonville-Hamburg levee drainage
23	Bayou des Glaises culvert
24	State Canal-Bayou Roseau drainage canal
25	Hamburg-Palmetto interceptor ditch
26	Bayou des Glaises diversion channel
27	Brushy Bayou Drainage structure
28	Brushy Bayou enlargement
29	Hamburg to Courtableau borrow pit
30	Bayou Darbonne drainage structure and channels
31	Bayou Courtableau diversion structure and channels
32	Bayou Courtableau drainage structure and channels
33	Bayou Berard drainage canal
34	Opelouses Bay to Lake Larose channel
35	Cypremont-Dauterive channel improvement
11	Charenton floodgate
36	Charenton drainage canal
37	Melville culverts
	DRAINAGE IMPROVEMENTS (EABPL)
38	Bayou Gerance drainage ditch
39	Lottie to Bayou Maringouin borrow pit
40	Bayou Boeuf-Bayou Long channel
41	Bayou Chene channel improvement
42	Tiger Island pumping plant
43	Front Street pumping plant

TABLE A-4-3 (Continued)

ATCHAFALAYA BASIN FLOODWAY SYSTEM PROJECT FEATURES

No.	Description
	RELOCATIONS AND ALTERATIONS
63	US 190 high level crossing
64	N.O.T. & M. railroad high level crossing
65	Ville Platte-Opelousas railroad connection
66	T. & P. railroad crossing at Melville
67	Gulf States Utilities powerline crossing
68	Raising Berwick Bay bridges
69	La. Hwy. 129 (La. 87) at Charenton Canal
70	US Hwy. 90 bridge at Charenton Canal
71	Southern Pacific railroad bridge at Charenton
72	La. & Ark. railroad bridge at Simmesport
73	N.O.T. & M. railroad bridge at Krotz Springs
74	US Hwy. 90 bridge at Wax Lake Outlet
75	Southern Pacific railroad bridge at WLO
76	La. Hwy. 1 at Morganza
77	T. & P. railroad at Morganza
78	Numerous pipelines, powerlines, etc.
79	T. & P. railroad, adjustment of track & fac.
	MAINTENANCE DREDGING
80	Maintenance dredging

TABLE A-4-4

LEVEES AND FLOODWALLS

Description	Total Length 1/	Deficient Length 1/	Completed Length 1/
Morganza Floodway guide levees:			
Upper guide levee	8.9	-	8.9
Lower guide levee	19.5	19.5	-
East Atchafalaya Basin Protection Levee:			
Levees and Floodwalls	87.2	64.2	23.0
West Atchafalaya Basin Protection Levee:			
Levees and Floodwalls	128.7	78.0	50.7
Atchafalaya River levees:			
East Atchafalaya River levee	52.5	-	52.5
West Atchafalaya River levee	60.1	4.5	55.6
Simmesport ring levee	1.6	-	1.6
Melville ring levee	4.1	-	4.1
Krotz Springs ring levee	1.7	-	1.7
Bayou des Glaises fuseplug levee	7.9	-	7.9
Mansura Hills to Hamburg levee	20.5	-	20.5
Levees west of Berwick	56.5	46.9	9.6
TOTAL	449.2	213.1	236.1

1/Length in miles.

through Morgan City to Avoca Island Cutoff and includes Bayou Sorrel and Bayou Boeuf locks. The length of this system is 87.2 miles, including about 15.5 miles of floodwall above Morgan City, 1.3 miles of floodwall along Morgan City front, and about 0.4 mile of floodwall below Morgan City. About 64.2 miles of this levee and floodwall are deficient and require additional work.

A.4.46. The West Atchafalaya Basin Protection Levee. The West Atchafalaya Basin Protection Levee begins near the town of Hamburg where it joins the Bayou des Glaises fuseplug levee. The levee extends in a south-southeasterly direction to Wax Lake Outlet at the latitude of the east and west Calumet floodgates, then eastward through Berwick and to the GIWW below Berwick. It covers 128.7 miles and includes 0.9 mile of floodwall along the front of the town of Berwick. Structures along the levee include Bayou Darbonne and Courtableau drainage structures, the Charenton floodgate, the east and west Calumet floodgates, and the Berwick lock, all of which are described subsequently.

A.4.47. The East Atchafalaya River Levee. This levee extends from the junction of the Atchafalaya, Old, and Red Rivers along the east bank of the Atchafalaya River to new Alabama Bayou, a distance of 52.5 miles. The levee is complete.

A.4.48. The West Atchafalaya River Levee. This levee extends southward from the Bayou des Glaises fuseplug levee at Simmesport along the west bank of the Atchafalaya River and Butte La Rose to Bayou Garofier, a distance of 60.1 miles. It also includes the Simmesport ring levee, 1.6 miles in length, and its drainage outlet, Brushy Bayou drainage structure; Melville ring levee, 4.1 miles in length, and its drainage structures; and the Krotz Springs ring levee, 1.7 miles in length. Total length of levee in this system is 67.5 miles. The levee is complete except for minor deficiencies along approximately 4.5 miles.

A.4.49. The Bayou des Glaises Fuseplug Levee. The Bayou des Glaises fuseplug levee extends from the town of Simmesport west and along the south bank of Bayou des Glaises to the West Atchafalaya Basin Protection Levee near Hamburg, a distance of 7.9 miles. This levee protects the lands in the West Atchafalaya Floodway from floodwaters in the Mississippi-Red River backwater area until stages requiring the use of the West Atchafalaya Floodway are reached. Floodwaters will then enter the floodway by natural and/or artificial crevassing of the levee. The Red River, Atchafalaya, and Bayou Boeuf Levee District is responsible for maintenance. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross-section.

A.4.50. The Mansura Hills to Hamburg Levee. This feature extends from the Mansura Hills, along the north bank of Bayou des Glaises to the state-owned drainage structure (Bordelonville floodgate) in Bayou

des Glaises, across the structure and southward to the junction of the West Atchafalaya Basin Protection Levee and the Bayou des Glaises fuseplug levee near the town of Hamburg, a distance of 20.5 miles. This levee serves as protection for the area west of the floodways and west of Marksville from the Mississippi-Red River backwaters but it is slightly deficient throughout its length. The Red River, Atchafalaya, and Bayou Boeuf Levee District is responsible for maintenance. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross-section.

A.4.51. The Levees West of Berwick. These levees consist of approximately 56.5 miles of intermittent levees, tying into high ground. They have been designed to protect the lands along the Teche and Sale Ridges from the backwaters created by diversion of floodwaters from the Mississippi and Red Rivers through the floodways, the Wax Lake Outlet, and the Lower Atchafalaya River.

A.4.52. The levee system begins at the lower end of the West Atchafalaya Basin Protection Levee below Berwick and extends generally westward along the north bank of the GIWW and east bank of Wax Lake Outlet, to the east Calumet floodgate. It continues on the opposite side of Wax Lake Outlet at the west Calumet floodgate, following a southerly and westerly direction along Wax Lake Outlet and the north bank of the GIWW to high ground at Bayou Sale, then follows along an irregular alinement around the Bayou Sale Ridge below the GIWW and northward above the GIWW to the Charenton Drainage Canal near Baldwin.

A.4.53. The levee system in this reach is maintained by the St. Mary Parish Police Jury. Primarily, maintenance includes mowing and inspection for levee caving and loss of cross section.

A.4.54. Morgan City to Tiger Island Improvements. Project features include levees, floodwalls, two pumping stations, and drainage culverts for the protection of Morgan City and areas to the east during high water stages in the Lower Atchafalaya Basin Floodway. Improvements north of the Southern Pacific Railway consist of approximately 213 linear feet of levee, 6,661 linear feet of reinforced concrete floodwall, and 1,600 linear feet of reinforced concrete box and pipe storm sewer. The improvements in the area south of the Southern Pacific Railroad, known as "Tiger Island," consist of approximately 8,180 linear feet of levees, 1,990 linear feet of floodwalls, a pumping station, 2,500 linear feet of corrugated metal pipe storm sewer, and drainage culverts with flap and sluice gates. A new floodwall through this entire area is required to protect against the higher flowline grades.

A.4.55. The Berwick Levee and Floodwall. This feature is located along the banks of Berwick Bay and the Lower Atchafalaya River fronting the city of Berwick in St. Mary Parish. The protective works consist of 1.6 miles of earthen levee and 0.9 mile of reinforced

concrete floodwall with gates at street intersections and pedestrian crossings, and a drainage structure to provide gated protection for a storm sewer that passes through the floodwall. Due to the higher flowline grades a new floodwall along the Berwick front is planned. The existing levee in this reach must also be raised and enlarged or a floodwall constructed to conform to standard requirements.

A.4.56. Construction of existing project features was completed in 1951 and operation and maintenance are local interest responsibility. Maintenance by local interests includes mowing and inspection for levee caving and loss of cross-section. Materials are stored for use in closing access gaps through the floodwall and for repairing minor structural cracks.

FLOOD CONTROL STRUCTURES

A.4.57. The Morganza Control Structure. This structure consists of about 19,340 linear feet of levee and a reinforced concrete structure having 125 gated openings, each 28 feet 3 inches wide, separated by 3-foot-wide piers. Each opening is equipped with a steel vertical-lift gate operated by a gantry crane. Bridges for the gantry crane, for LA Highway 1, and for the joint track for the Kansas City Southern and Texas and Pacific Railways are also supported on the structure piers. The earthen embankment on each side of the control structure also serves to carry the highway and railroads across the floodway. Design capacity for the structure is 600,000 cfs.

NAVIGATION WORKS

A.4.58. Descriptive data on navigation works associated with the Atchafalaya Basin Floodway system are presented in Table A-4-5 and are discussed in subsequent paragraphs.

A.4.59. Atchafalaya River Channel. This channel, 12 feet deep over a bottom width of 125 feet, extends from the GIWW at Morgan City to the Mississippi River via the Atchafalaya and Old Rivers.

A.4.60. Bayou Sorrel Lock. The Bayou Sorrel lock consists of two reinforced concrete gate bays equipped with steel sector gates and connected with an earthen chamber having a timber guide wall on each side. The length is 800 feet, the clear width is 56 feet, and the sill elevation is minus 14 feet NGVD. The lock provides for navigation through the East Atchafalaya Basin Protection Levee as a part of GIWW Morgan City to Port Allen alternate route.

TABLE A-4-5

NAVIGATION WORKS

Description	Usable Length (ft)	Length	Width (ft)	Depth (ft NGVD)	Date Completed
Atchafalaya Basin navigation channel		116 miles	125	-12.8	Feb 56
Bayou Sorrel lock	790	800 feet	56	-14.0	Oct 52
Charenton floodgate		175 feet	45	-10.8	Jul 48
Floodgate bridge		45 feet		1/	Mar 51
Calumet floodgates (2 each)		161 feet	45	-9.8	Sep 50
Berwick lock	300	307 feet	45	-9.8	Nov 50
Bayou Boeuf lock	1148	1,158 feet	75	-13.8	Jun 54
Rerouting GIWW below Morgan City		10.1 miles	125	-12.8	2/
East access channel		12.1 miles	80	-7.0	Nov 66
West access channel		11.6 miles	80	-7.0	Aug 67

1/ Low steel of bridge at 20.7 feet NGVD.
2/ Incomplete.

A.4.61. Charenton Floodgate and Bridge. This floodgate is a reinforced concrete structure 175 feet long with a clear width of 45 feet, a bottom elevation of minus 10.8 feet NGVD with steel sector gates. The floodgate provides for release of intercepted drainage into the Atchafalaya Basin Floodway and also for navigation through the West Atchafalaya Basin Protection Levee. A removable bridge with a low steel elevation of 20.7 feet NGVD has been constructed across the structure.

A.4.62. East and West Calumet Floodgates. Each floodgate is a reinforced concrete structure 161 feet long with a 45-foot clear width, a sill elevation of minus 9.8 feet NGVD with steel sector gates. These floodgates provide for drainage of waters from Bayou Teche and for navigation through the Wax Lake Outlet guide levees.

A.4.63. Berwick Lock. This lock is a 45-foot wide reinforced concrete structure which has a sill elevation of minus 9.8 feet NGVD and a usable length of 300 feet between steel sector gates. The lock provides for navigation between Bayou Teche and the Lower Atchafalaya River, through the West Atchafalaya Basin Protection Levee.

A.4.64. Bayou Boeuf Lock. This lock consists of two reinforced concrete gate bays equipped with steel sector gates connected by an earthen chamber that has a timber guide wall on one side. The lock has a length of 1,156 feet, a clear width of 75 feet, a sill elevation of minus 13.8 feet NGVD and provides for navigation in Bayou Boeuf through the East Atchafalaya Basin Protection Levee.

A.4.65. Rerouting GIWW below Morgan City. This feature provides for rerouting the GIWW around and below Morgan City, through Bayou Chene and the Lower Atchafalaya River, thereby bypassing the existing Bayou Boeuf lock.

A.4.66. East and West Access Channels. This feature consists of channels, minus 7.0 feet NGVD by 80 feet, which provide navigable connections between the east and west Atchafalaya guide levees. An additional function of these channels is to distribute freshwater to the overbank areas they traverse.

A.4.67. Enlargement Dredging (Barbre Landing to Alabama Bayou). This feature consists of improving the discharge capacity of the leveed channel of the Atchafalaya River (mile 0 to mile 54) by the enlargement of restricted sections of the channel, including the enlargement and alteration of existing railroad and highway bridges that may be required.

A.4.68. Distributary Closures. This feature provides for closures of distributary channels to facilitate development of the main channel through the lower basin. Closure construction consists of embankments built with locally available clay placed by hydraulic dredge. The closures constructed to date are shown in Table A-4-6.

TABLE A-4-6

DISTRIBUTARY CLOSURES

Location (River mile)	Closure Name	Date Completed
54.5 L	Alabama Bayou	Nov 1954
55.8 L	Bayou Des Ourses	Nov 1954
58.4 R	Unnamed	Oct 1956
59.5 L	Bayou des Glaises	Oct 1956
63.7 R	Upper Grand River	Feb 1963
66.7 R	Big Tensas Bayou	Jun 1956
67.8 L	Upper Grand River	Jun 1956
70.5 R	Logan Chute	Aug 1963
74.5 R	Lake Mongoulois	May 1962
76.5 L	Jakes Bayou (lower end)	Oct 1959
78.7 L	Little Coon Trap Bayou	Oct 1959
79.6 L	Lake Chicot	Oct 1959
83.9 R	West Fork Chicot Pass	Oct 1959
85.2 R	Oil Company Canal	Aug 1959
86.9 R	Unnamed	Aug 1959
90.5 R	Unnamed	Feb 1961
91.7 R	Unnamed	Feb 1961
92.5 L	Shell Bayou	Feb 1961
93.8 R	Unnamed	Feb 1961
94.1 R	Unnamed	Feb 1961

A.4.69. Enlargement Dredging (below Whiskey Bay). This feature consists of dredging a continuous deep main channel through the central portion of the Atchafalaya Basin, extending from the Atchafalaya River at Alabama Bayou (mile 54.5) through the basin into the main body of Grand Lake (mile 112.3). Work completed to date is shown in Table A-4-7.

A.4.70. Revetments. The revetment program provides for revetments to stabilize the channel of the Atchafalaya River, primarily in the leveed reach of the river. Details on the revetments are shown in Table A-4-8.

DRAINAGE IMPROVEMENTS

A.4.71. Drainage Improvements Associated with the East Atchafalaya Basin Protection Levee. These improvements are shown in Table A-4-9 and are described subsequently.

- Bayou Gerance Drainage Ditch.

- Lottie to Bayou Maringouin Borrow Pit Enlargement. This consists of the enlargement of the restricted sections of the landside borrow pit, beginning at a point one-quarter mile south of Lottie and continuing to Bayou Maringouin.

- Bayou Boeuf-Bayou Long Drainage Canal. This canal features the improvement of existing streams along the landside of the East Atchafalaya Basin Protection Levee from the Bayou Sorrel lock to the vicinity of Lake Palourde, a new landcut around the east side of Lake Palourde to Bayou Boeuf, and the enlargement of Bayou Boeuf to provide a minimum channel 9 feet by 100 feet for drainage and navigation from the GIWW to the levee borrow pit.

- Bayou Chene Channel Improvement. This improvement to restricted sections of Bayou Chene provides a minimum channel 9 feet by 100 feet for drainage.

- Tiger Island Pumping Plant. This provides for interior drainage at Morgan City.

- Front Street Pumping Plant. This provides for interior drainage at Morgan City.

A.4.72. Drainage Improvements Associated with the West Atchafalaya Basin Protection Levee. These improvements are shown in Table A-4-10 and are described subsequently.

TABLE A-4-7

ENLARGEMENT DREDGING

Location (River mile)		Completed Channel Size (ft^2)	Volume Dredged (cu. yds.)	Completed 1/
54.5 - 60.6	Whiskey Bay Pilot Channel	60,000	14,069,000	Sep 62
60.6 - 63.7	Whiskey Bay Pilot Channel	60,000	12,954,000	Feb 63
63.7 - 67.8	Upper Grand River	60,000	9,548,000	Jul 66
67.8 - 70.5	Blind Tensas Cut	60,000	15,126,000	Aug 63
70.5 - 76.0	Lake Mongoulois-Bayou Chene Cut and Tarlton Bayou	60,000	18,510,000	May 66
76.0 - 80.2	Tarlton Bayou, Bayou Chene and Chicot Pass	60,000	21,192,000	Dec 66
80.2 - 85.1	Chicot Pass	60,000	29,430,000	Dec 66
85.1 - 91.0	Chicot Pass	60,000	40,042,000	May 64
91.0 - 96.2	Chicot Pass and Grand Lake	60,000	30,408,000	May 64
96.2 - 103.4	Grand Lake and Cypress Pass	40,000	22,164,000	May 66
103.4 - 112.3	Cypress Pass and Sixmile Lake	40,000	24,860,000	Feb 68

1/ Additional work is planned; enlargement discontinued in 1968 due to lack of funding and discontinued since 1971 pending filing of an Environmental Impact Statement with Environmental Protection Agency.

TABLE A-4-8
REVETMENTS

Location (River mile)		Revetment Name	Required	Completed	Uncompleted 1/	Date Completed 2/
4.0	L	Legonier	2.3	1.7	0.6	1973
5.5	R	Simmesport	2.4	2.0	0.4	1970
7.5	L	Kuhlman Bayou	1.1	1.1	-	1975
8.0	R	Odenburg	1.5	1.0	0.5	1974
10.0	L	Jacoby	1.7	-	1.7	-
12.5	R	Cason	1.5	-	1.5	-
13.5	L	McCrea	1.3	1.0	0.3	1974
14.5	R	Woodside	3.1	2.5	0.6	1974
17.0	L	Provosty	2.0	1.5	0.5	1969
18.5	R	Crooked Bayou	2.1	1.8	0.3	1969
21.5	L	Mercier	2.9	1.6	1.3	1972
23.5	R	Barberton	0.9	-	0.9	-
24.0	L	Evans Point	1.3	0.5	0.8	1971
25.5	R	Goudeau	1.0	0.7	0.3	1974
26.5	L	Morris Bayou	1.2	0.7	0.5	1972
27.5	R	Goodwood	1.3	0.8	0.5	1970
28.5	L	Red Cross	1.6	0.0	1.6	-
29.5	R	Melville	1.5	0.9	0.6	1972
31.0	L	Cross Bayou	1.3	0.7	0.6	1974
32.0	R	Melville South	1.9	0.8	1.1	1972
34.6	L	Toles	2.0	1.2	0.8	1970
35.5	R	Petite Prairie	1.4	1.0	0.4	1975
37.0	L	Holloway Lake	1.1	1.1	-	1974
38.0	R	Three Mile Bayou	0.7	0.0	0.7	-
38.5	L	Bayou Sherman	0.8	0.0	0.8	-
40.5	R	Krotz Springs	2.8	0.9	1.9	1973
43.5	L	East Krotz Springs	1.4	0.0	1.4	-
44.5	R	Sherburne	1.8	1.3	0.5	1974
48.0	L	Bayou Big Graw	3.0	0.0	3.0	-
48.5	R	Caswell Bayou	1.1	0.0	1.1	-
50.0	L	Courtableau Bayou	1.2	0.0	1.2	-
52.0	R	Alabama Bayou	1.5	0.0	1.5	-
53.0	L	Indian Bayou	1.5	0.0	1.5	-
54.0	R	Happytown	1.3	0.0	1.3	-
115.0	L	Otis Landing	1.1	0.0	1.1	-
		Morgan City Front	1.4	0.6	0.8	1967
		TOTALS	58.0	25.4	32.6	

1/ Length in miles.
2/ Date work in place completed.

TABLE A-4-9

DRAINAGE IMPROVEMENTS ASSOCIATED
WITH THE EAST ATCHAFALAYA BASIN PROTECTION LEVEE

Description and Location	Pertinent Data	Date Completed
Bayou Gerance drainage ditch		Jun 39
Lottie to Maringouin borrow pit	Consists of enlargement of the restricted section of the landside borrow pit between a point one-quarter mile south of Lottie and Maringouin.	Feb 40
Bayou Boeuf-Bayou Long Channel	Consists of the improvement of existing streams along the landside East Atchafalaya Basin Protection Levee from the Bayou Sorrel lock to the vicinity of Lake Palourde, a new land cut around the east side of Lake Palourde to Bayou Boeuf, and the enlargement of Bayou Boeuf to 9 feet by 100 feet for drainage and navigation.	Jun 47
Bayou Chene channel improvement	Provides for enlargement of restricted (9 feet by 100 feet) sections of Bayou Chene to provide a 9 feet by 100 feet channel for drainage and navigation.	Jun 47
Tiger Island pumping plant	Consists of three pumps with a total capacity of 138 cfs at 5.0 feet head.	May 55
Front Street pumping plant	Original plant consisted of two pumps with a capacity of 35 cfs at 16.0 head. One pump has been replaced and present capacity is 58 cfs.	

TABLE A-4-10

DRAINAGE IMPROVEMENTS ASSOCIATED WITH
THE WABPL

Description and Location	Pertinent Data	Date Completed
Bordelonville-Hamburg levee drainage		Apr 1943
Bayou des Glaises culvert, near Hamburg	72-inch diameter CMP, approx. 200 ft long, w/concrete stilling basin	Dec 1938
State Canal-Bayou Roseau drainage canal, near Hamburg	25-foot bottom width, variable depth	Aug 1945
Hamburg-Palmetto interceptor ditch, (floodway side)		Aug 1938
Bayou des Glaises diversion channel, near Moreauville		Sep 1938
Brushy Bayou drainage structure, near Simmesport	Reinforced concrete box culvert, 5 ft x 6 ft., approx. 185 ft. long, with steel headgate	Dec 1947
Brushy Bayou enlargement, near Simmesport		May 1942
Hamburg to Courtableau borrow pit, (landside of WABPL)		May 1939
Bayou Darbonne drainage structure and channels, near Port Barre	Reinforced concrete box culvert, 1 barrel, 10 ft x 10 ft. x 265 ft. with gate	Feb 1941
Bayou Courtableau diversion structure (2 weirs) and channels	Reinforced concrete weirs, 2 each, crest at 18.0 ft. NGVD, length 503 ft.	May 1942
Bayou Courtableau drainage structure and channels, near Port Barre	Reinforced concrete box culvert, 5 barrels, 10 ft. x 15 ft. x 220 ft. with gates	May 1956
Bayou Berard drainage canal, (landside)		Mar 1940
Opelousas Bay to Lake Larose channel (floodway side)		Oct 1948
Cypremont-Dauterive channel improvement, (landside borrow pit)	75 ft. bottom width, -15.0 NGVD bottom elevation, approx. 14.3 miles	Feb 1941
Charenton floodgate, near Charenton	Reinforced concrete navigable floodgate, 45 ft. x -10.8 ft. NGVD x 175 ft.	Jul 1948
Charenton drainage canal, from Lake Fausse Pointe to Gulf of Mexico	75 ft. x -30.0 NGVD x approx. 15 miles	Sep 1948 1/
Melville culverts, at Melville	72-inch diameter CMP (2 each), approx. 225 ft. long, with gates	Sep 1948

1/ Original channel completed Apr 1940, enlargement completed Sep 1948.

• Bordelonville-Hamburg Levee Drainage. This improvement consists of a drainage ditch parallel to the lower portion of the Mansura Hills to Hamburg levee, which drains the interior of the Bayou des Glaises loop.

• Bayou des Glaises Culvert. This structure consists of a 72-inch corrugated pipe culvert with flap gate and concrete stilling basin. The culvert passes through the old Bayou des Glaises levee (non-Federal), connecting the floodway side borrow pit of the Bordelonville-Hamburg levee with Bayou des Glaises proper, and providing an outlet for the water accumulating within the Bayou des Glaises loop.

• State Canal - Bayou Roseau Drainage Canal. This improvement consists of an enlarged channel to take off some landside drainage intercepted by the Mansura Hills to Hamburg levee.

• Hamburg-Palmetto Interceptor Ditch. This improvement provides drainage along the floodway side of the West Atchafalaya Basin Protection Levee between Hamburg and the state drainage canal.

• Bayou des Glaises Diversion Channel. This channel connects Bayou des Glaises with the landside borrow pit of the West Atchafalaya Basin Protection Levee.

• Brushy Bayou Drainage Structure. This improvement consists of a 5-foot by 6-foot reinforced concrete structure that provides drainage from the interior of the Simmesport ring levee into the West Atchafalaya Floodway.

• Brushy Bayou Enlargement. This consists of enlargement and improvement of Brushy Bayou and Yellow Bayou to provide an outlet from the Brushy Bayou drainage structure to the state drainage canal (non-Federal).

• Hamburg to Courtableau Borrow Pit Enlargement. This improvement consists of enlarging inadequate sections of the existing borrow pit.

• Bayou Darbonne Drainage Structure. This structure consists of a reinforced concrete box culvert, 10 feet by 10 feet by 265 feet long, with a manually-controlled gate. It is located in the West Atchafalaya Basin Protection Levee at the Bayou Darbonne crossing.

• Bayou Courtableau Diversion Structure and Channels. These improvements consist of two wide, shallow, reinforced concrete weirs with crests of 18.0 feet above NGVD and widths of 503 feet, constructed on the south bank of Bayou Courtableau. The outlet channels connect to the West Atchafalaya Basin Protection Levee borrow pit south of the weirs.

• Bayou Courtableau Drainage Structure and Channels. These improvements consist of a reinforced concrete box-type culvert with five barrels (each 10 feet by 15 feet and 220 feet long), with five mechanically-operated vertical lift gates at the outlet end; an inlet channel approximately 1,800 feet long with a bottom width of 100 feet and 1V on 2H side slopes; an outlet channel approximately 23,500 feet long with a bottom width of 120 feet and side slopes 1V on 3H; a 1,300-foot levee along the south bank of the inlet channel with a 12-foot-wide gravel road on the crown; and guide levees on both banks of the outlet channel (constructed from disposal material) for confining drainage flows passed through the structures.

• Bayou Berard Drainage Canal. This canal extends from the landside borrow pit in the vicinity of Cypremont, about 3 miles below Henderson Lake, to the head of Lake Catahoula, a distance of 7 miles. The Bayou Berard drainage canal has a bottom width of 65 feet, 15 feet below NGVD.

• Opelousas Bay to Lake Larose Channel. This consists of a channel connecting the lower (south) end of Opelousas Bay with Bayou LaRose.

• Cypremont-Dauterive Channel Improvement. This channel extends in a southerly direction in the landside borrow pit, beginning about 1 mile south of Cypremont and ending opposite the head of Lake Dauterive, a distance of 14.3 miles.

• Charenton Floodgate. This is a reinforced concrete structure 175 feet long with a clear width of 45 feet, a bottom 10.8 feet below NGVD, and steel sector gates. A removable bridge with a low steel elevation of 20.7 feet NGVD, exists across the structure.

• Charenton Drainage Canal. This is a drainage connection that begins at Lake Fausse Pointe, extends through the landside borrow pit of the West Atchafalaya Basin Protection Levee to the Charenton floodgate, through a landcut to Bayou Teche near Charenton, then extends along Bayou Teche to a point near Baldwin, through a landcut to West Cote Blanche Bay, an arm of the Gulf of Mexico. The canal has a bottom width of 75 feet, 30 feet below NGVD, and a design discharge capacity of approximately 22,000 cfs.

• Melville Culverts. These consist of two gated corrugated metal culverts, which provide drainage from the interior of the Melville ring levee to the West Atchafalaya Basin Floodway. Each culvert is 72 inches in diameter and is equipped with a steel lift gate on the floodway side.

A.4.73. Drainage Improvements Associated with Pointe Coupee Loop. These include the following:

- Pointe Coupee Drainage Structure. An existing drainage system for the upper Pointe Coupee Parish area, which is protected by the upper guide levee of the Morganza Floodway, was provided with construction of the Point Coupee Drainage Structure at the intersection of the levee and Bayou Latenache and the enlargement of the bayou from the structure to US Highway 190. The structure, located about 0.5 mile east of the Atchafalaya River, is reinforced concrete supported on untreated timber piles and contains two electrically-operated steel lift gates, each 10.5 feet wide and 15.0 feet high. This feature was completed in 1942 and modified in 1975. Operation and maintenance are the responsibility of the US Army Corps of Engineers.

- Pointe Coupee Pumping Station. Additional work originally planned for the Pointe Coupee area consisted of the enlargement of Bayou Latenache. As a result of drainage problems within the Pointe Coupee loop during the 1973 flood, studies were made that concluded a pumping station in lieu of enlarging Bayou Latenache outlet channel was economically justified.

A.4.74. Drainage Improvements West of Berwick. These improvements consist of a system of low level collection ditches, drainage structures, gated culverts, pumping plants, and ancillary work to provide interior drainage for the protected (inclosed) areas. Details of these improvements are shown in Table A-4-11. Deltaic activity has caused a progressive increase in gulfside stages for any given floodway discharge and therefore, in the stages for the design return frequency at each pumping plant discharge. As a result, there is now a shortfall in the capacity of each station for the design case; and since deltaic activity will continue, the shortfall will increase with time until deltaic stability is reached. Investigations are now underway to modify the pumping stations to restore the original design capacities for projected future floodside stages.

A.4.75. Lower Atchafalaya River. This feature is described under principal project features, paragraph A.4.24.

A.4.76. Wax Lake Outlet. This feature is described under principal project features, paragraph A.4.25.

IMPROVEMENTS FOR ACCESS, FISH AND WILDLIFE, AND RECREATION

A.4.77. Roads on Levees. Levee roads are provided to maintain an access road system. On the East Atchafalaya Basin Protection Levee

TABLE A-4-11

INTERIOR DRAINAGE WORKS WEST OF BERWICK, LOUISIANA

1. Bayou Yokely Area.

Feature	Pertinent Data	Status
Pumping plant	Enlarged to pump capacity of 580 cfs at a static head of 2.5', provided by 3 pumps of 193 cfs capacity.	Completed
Drainage structure	Four 72" diameter floodgates with capacity to discharge the design flood with sump pool stages limited to 3.5' Automatic flap and normal slide type gates.	Completed 9 Apr 1963
Gated culverts	2-gated culverts into Bayou Yokely	In place
Low level drainage ditches	Approximately 3.6 miles in length along the western and southern boundaries of the Bayou Yokely Area	Completed

2. Franklin Area.

Feature	Pertinent Data	Status
Pumping plant	Enlarged to total pump capacity by 260 cfs by addition of a pumping station with 2 pumps of 58 cfs capacity. Existing station has 2 pumps of 72 cfs capacity.	Completed
Gated culverts	Three 60" CMP culverts with automatic flap gates.	In place
Low level drainage ditches	Approximately 4.2 miles in length along the western and southern boundaries of the Franklin area.	Completed

3. Centerville Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 330 cfs at a static head of 2.5' is provided by 3 pumps of 110 cfs capacity each.	Completed 25 May 64
Gated culverts	Three 60" CMP culverts through the levee at the pumping station.	In place
Gated culvert	One 60" CMP culvert with flapgate.	In place
Low level drainage ditches	Approximately 4.8 miles in length generally along the southern boundary.	In place

4. Maryland Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 134 cfs at a static head of 2.5' is provided by 2 pumps at 67 cfs capacity.	Completed 31 May 1957
Gated culverts	Three 60" CMP culverts with flapgates.	In place
Gated culvert	One 36" CMP culvert with flapgate.	In place
Low level drainage ditches	Approximately 3.6 miles in length along the northern & western boundaries of the Maryland area.	Completed

5. North Bend Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 50 cfs at a static head of 3' is provided by 2 pumps of 25 cfs capacity.	Completed 15 Nov 1962
Gated culvert	One 60" CMP culvert with floodgate.	In place
Gated culverts	Two 36" CMP culverts with floodgate.	In place
Low level drainage ditches	Approximately 1.9 miles in length along the western boundary of the North Bend Area.	Completed

TABLE A-4-11 (Continued)

INTERIOR DRAINAGE WORKS WEST OF BERWICK, LOUISIANA

6. Ellerslie Area.

Feature	Pertinent Data	Status
Pumping plant	A pumping capacity of 140 cfs at a static head of 3' by 2 pumps of 70 cfs capacity.	Completed 8 Apr 1953
Gated culverts	Two 60" CMP culverts with floodgates.	In place
Gated culverts	One 60" CMP and one 72" GIP with floodgates.	In place
Low level drainage ditches	Approximately 6.2 miles in length generally along all boundaries except the NE portion of the Ellerslie area.	Completed

7. Gordy Area.

Feature	Pertinent Data	Status
Pumping plant	Pump capacity of 230 cfs at a static head of 2.5' is provided by one 50 cfs and two 90 cfs pumps.	Completed 10 Feb 1964
Gated culverts	Two 60" CMP culverts with automatic flapgates; gravity drained	In place
Low level drainage ditches	Approximately 8.5 miles in length generally along all boundaries except the NE portion of the Gordy area.	Completed

8. Wax Lake West Area.

Feature	Pertinent Data	Status
Pumping plant	Pump capacity of 500 cfs at a static head of 4' provided by 3 pumps of 167 cfs capacity.	Completed 13 Apr 1965
Drainage structures	Contains 15 automatic flap gates having a total cross sectional area of 285 sq. ft. and a capacity of 3"/day under a 1' head differential; gravity drained.	Completed 16 Jun 1954
Low level drainage ditches	Approximately 3.4 miles in length along a portion of the southern boundary.	Completed

9. Wax Lake East Area.

Feature	Pertinent Data	Status
Pumping plant	A pump capacity of 1,000 cfs at a static head of 6' is provided by 4 pumps of 250 cfs capacity.	Completed 7 Dec 61
Drainage structure	Consists of a gated floodwall type control structure with 25 combination automatic flap gate & manually controlled slide gates, each 5' in diameter.	Completed 18 Dec 1954
Gated culverts	Three gated culverts	In place
Gated culverts	Two gated culverts.	Authorized; const. not begun
Inverted siphon	Maximum discharge of 1,150 cfs Structure consists of siphon approach & ext. channels, siphon intake section, trash rack, barrel, outlet section, and connecting channel & culvert inlet outlet & barrel.	Completed 27 Aug 63
Low level drainage ditches	Approximately 24.4 miles in length generally along the entire boundary except for a small portion (approx. 4 mi)	Completed
Channel closures	Two closures consisting of embankment placed by hydraulic dredge.	Completed

and West Atchafalaya Basin Protection Levee, final location of the roadway will, for the most part, be on the landside berm. This roadway, will have a 20-foot crown graded a minimum of one-foot above the 25-year design flood on the landside. After roadways have been constructed, gravel surfacing will be applied. Table A-4-12 shows the location and length of the roads.

A.4.78. Public Use Areas. A program has been proposed to develop 29 recreation areas, including parking and boat-launching facilities. Table A-4-13 contains basic information on the sites. (This is not the public use plan that is being considered in this study.)

A.4.79. East and West Access Channels. This feature consists of channels, minus 7 feet by 80 feet, which provide navigable connections between the east and west Atchafalaya guide levees. An additional function of these channels is to distribute freshwater to the overbank areas they traverse. Maintenance dredging of the channels averages about 750,000 cubic yards per year. The disposal is confined to the banks adjacent to the waterways.

A.4.80. East and West Freshwater Distribution Channels. These are maintained to distribute freshwater to the east and west sides of the Lower Atchafalaya Basin Floodway during seasons of low water. Maintenance consists of removal of obstructions such as debris, sediments, and other major obstacles to flow.

A.4.81. East and West Freshwater Diversion Structures. Each structure will consist of two 10-foot by 10-foot gated reinforced concrete culverts. Water introduced by gravity flow into the Ramah area of the Lower Atchafalaya Basin Floodway, east of the Atchafalaya River, will be distributed by the structure at Sherburne through Big Alabama Bayou, Bayou des Glaises, and connecting channels. Water introduced into the Henderson Lake area of the Lower Atchafalaya Basin Floodway, west of the Atchafalaya River, will be distributed by the Bayou Courtableau freshwater diversion structure through Little Fordoche Bayou and connecting swamp channels.

A.4.82. Dredge Material Retaining Dikes. A system of retention dikes has been provided to prevent damage to high value fish and wildlife habitat in the Lower Atchafalaya Basin Floodway. These disposal retention dikes serve to confine dredged material.

FLOWAGE EASEMENTS

A.4.83. Below Krotz Springs. The Flood Control Act of 15 May 1928, as amended by the Flood Control Act of 28 June 1938, authorized the Chief of Engineers to purchase flowage easements over all lands below

TABLE A-4-12

ROADS ON LEVEES

Description	Length In Miles
Roads, gravel or shell-surfaced:	
Morganza upper guide levee	8.9
Morganza lower guide levee	19.5
East Atchafalaya Basin Protection levee	85.5
West Atchafalaya Basin Protection levee	127.7
East Atchafalaya River levee	52.5
West Atchafalaya River levee	60.1
Simmesport ring levee	1.6
Melville ring levee	4.1
Krotz Springs ring levee	1.7
Bayou des Glaises fuseplug levee	7.9
Mansura Hills to Hamburg levee	20.5
Levees west of Berwick	56.5
TOTAL	446.5

TABLE A-4-13

PUBLIC USE AREAS

Site No.	Location	Proposed Improvements: Concrete Ramp	Launching Area (ft^2)	Parking Area (ft^2)	Other
1	Ramah	-----	18,000	40,000	Levee ramp
2	Bayou Maringouin	3 lanes	18,000	60,000	Levee ramp
3	Upper Grand River	5 lanes	18,000	100,000	Levee ramp
4	Bayou Sorrel	5 lanes	18,000	400,000	Levee ramp
5	Big Bayou Pigeon	5 lanes	18,000	100,000	Levee ramp
6	Bayou Postillion	3 lanes	18,000	60,000	Levee ramp
7	Old River	5 lanes	18,000	100,000	Levee ramp
8	Belle River	5 lanes	18,000	100,000	Levee ramp
9	Little Bayou Sorrel	3 lanes	18,000	60,000	Levee ramp
10	Flat Lake	5 lanes	18,000	100,000	Levee ramp
11	Bayou Boeuf	2 lanes	------	26,400	Access road (0.2 mile)
12	Bayou Courableau	6 lanes	------	90,000	Access road (0.5 mile)
13 1/	Henderson Lake	15 lanes	36,000	300,000	Levee ramps(3)
14	Catahoula	2 lanes	12,000	40,000	Levee ramp
15	Bayou Benoit	------	------	50,000	Misc. fac.
16	Grand Bayou	5 lanes	18,000	400,000	Levee ramp
17	Little Lake Long	3 lanes	18,000	60,000	Levee ramp
18	Lake Fausse Pointe	2 lanes	18,000	40,000	Misc. fac.
19 1/	Charenton Beach	5 lanes	18,000	200,000	0.4 mile of roads, levee ramp, fill, etc.
20	Myette Point	-----	-----	50,000	Misc. fac.
21	Verdunville Landing	5 lanes	18,000	100,000	Levee ramp
22	Wax Lake Outlet	2 lanes	-----	40,000	Levee ramp
23	Lower Atchafalaya Closure	5 lanes	18,000	100,000	Levee ramp
24	GIWW Landing	5 lanes	18,000	100,000	Levee ramp
25	Swayze Lake	2 lanes	------	25,000	Access road (0.1 mile)
26	Sherburne structure	2 lanes	18,000	48,000	Misc. fac.
27 1/	Bayou des Glaises, Pat's Throat & Little Tensas Bayou	2 lanes (3)	------	33,000 (3)	Access road (19.0 miles)
28	Courtableau Structure	2 lanes	12,000	48,000	Misc. fac.
29	Opelousas Bay	3 lanes	18,000	60,000	Access road (0.6 mile)
	TOTALS	85 lanes	348,000	2,397,000	
	2/	111 lanes	402,000	3,997,000	

1/Approval deferred-Letter ENGCW (NOD 25 May 67); Subject: Public Access and Recreational Development.

2/Totals including deferred sites.

the latitude of Krotz Springs that were not considered subject to frequent overflow as of 1928. As determined by the Chief of Engineers at that time, only those lands on which the title was clear (and the owner had presented a claim and was agreeable to the appraised value) were subject to the payment of flowage easements. Condemnation was not authorized. Due to the costliness of this process, acquisition of easements in this category is on a case-by-case basis.

A.4.84. West Atchafalaya Floodway. Perpetual flowage easements on approximately 154,347 acres were acquired by the Government over all lands and improvements in the floodway down to the latitude of Krotz Springs. These easements provide for full use of the lands for flood control purposes. Owners retain the rights to farm, improve, build houses and inhabit the lands, and to harvest timber and minerals.

A.4.85. Morganza Floodway. Comprehensive easements on approximately 71,577 acres of land within the floodway have been acquired for the passage of floodwaters into the Lower Atchafalaya Basin Floodway. Construction for permanent habitation within the floodway is not permitted, but use of the land for farming, removal of timber and minerals, and other purposes not in conflict with flood control is permitted with prior approval.

A.4.86. Upper Pointe Coupee Area. Inundation rights have been acquired on 12,801 acres of land above the Pointe Coupee drainage structure for storage of runoff when it becomes necessary to close the gates in the upper guide levee during operation of the Morganza Floodway.

A.4.87. Morgan City Front. Flowage easement has been acquired on 18 acres in connection with the Morgan City front levee.

A.4.88. Bayou des Glaises Loop. Flowage easements have been acquired on approximately 16,091 acres within the Bayou des Glaises loop.

A.4.89. Bayou Chene. Flowage easements have been acquired on 692 acres.

RELOCATIONS AND ALTERATIONS

A.4.90. Details on the relocations and alterations accomplished are shown in Table A-4-14.

A.4.91. US 190 High Level Crossing. This crossing, between Lottie and Courtableau, consists of approximately 12 miles of an elevated four-lane twin-bridge highway, averaging about 29 feet above natural ground level. This crossing is made of a combination of earth embankment and reinforced concrete bridge supported by piling. During

TABLE A-4-14

RELOCATIONS AND ALTERATIONS

No.	Feature	Type	Dimensions			Status
			Length	Height	Clear Width	
63	US 190 High Level Crossing	New const.	Approx.	29. feet avg.	56 feet	Completed
64	The New Orleans, Texas, and Mexico Railway High Level Crossing	New const.	12 miles		11 feet	Completed Sep 1961
65	Opelousas-Ville Platte-Bunkie RR Connection	New const. Alterations	16 miles 20 miles			Completed Feb 1950
66	Texas & Pacific RR Crossing at Melville	Alteration	687 feet addition	50.2 feet	-	Completed Nov 1952
67	Gulf States Utilities Powerline Crossing	New const.	3,500 feet ±	Power Line (varies) 270 feet ± (structures)		Completed
68	Raising Berwick Bay Bridges (So. Pacific Railway & US Hwy. 90 Bridges)	Alteration				Completed
69	LA Hwy. 129 (LA Hwy 87) Bridge (Charenton Canal)	New const.				Completed Nov 1940
70	US 90 Bridge (Charenton Canal)	New const.				Completed Jun 1940
71	Texas & New Orleans RR Bridge (Charenton Canal)	New const.				Completed Dec 1941
72	Louisiana & Ark RR Bridge (Simmesport)	Alteration	897 feet addition	--	--	Completed Dec 1938
73	New Orleans, Texas, & Mexico RR Bridge (Krotz Springs)	Alteration	1,270 feet addition	--	--	Completed 1941
74	US 90 Bridge (Wax Lake Outlet)	New const.				Completed Nov 1942
75	Southern Pacific RR Bridge (Wax Lake Outlet)	New const.				Completed Nov 1942
76	LA Hwy. 1 (Morganza)	New const.		63.76 feet	30 feet ±	Completed Feb 1960
77	Texas & Pacific RR Bridge (Morganza)	New const.		64.25 feet	15 feet ±	Completed Feb 1960
78	Numerous oil & gas pipelines, powerlines, etc.	New const. & alterations				
79	Texas & Pacific High Level RR Crossing McKneeley to Palmetto and adjustment of tracks and facilities	Alterations				Completed Nov 1967

operation of the floodway, this crossing will provide a usable east-west highway route.

A.4.92. The New Orleans, Texas, and Mexico Railway High-Level Crossing. This crossing, between Lottie and Courtableau, provides means by which uninterrupted traffic can be maintained by the New Orleans, Texas, and Mexico Railroad; the Texas and Pacific Railway, the Missouri Pacific Railroad, and the Kansas City Southern Railway during floods when operation of the West Atchafalaya Floodway is required. The single-track, high-level crossing, approximately 12 miles long, is composed of earth embankment and reinforced concrete ballaster deck-type trestle supported on piling.

A.4.93. Opelousas-Ville Platte-Bunkie Railway Connection. The Opelousas-Ville Platte-Bunkie Railway connection, located west of the West Atchafalaya Floodway between Opelousas and Bunkie, was constructed in lieu of two additional high-level crossings over the West Atchafalaya Floodway for the Texas and Pacific and the Kansas City Southern Railways. The connection included construction of 16 miles of new single-track railroad between Opelousas and Ville Platte and the rehabilitation and strengthening of about 20 miles of single-track railroad between Ville Platte and Bunkie.

A.4.94. Texas and Pacific Railroad Crossing at Melville. This crossing consists of a 687-foot addition to the existing railroad crossing.

A.4.95. Gulf States Utilities Powerline Crossing. This powerline is elevated over the Whiskey Bay Pilot Channel.

A.4.96. Raising Berwick Bay Bridges. To accommodate navigation during diversion of floodwaters through the Atchafalaya Basin, the railway (Southern Pacific) and highway (US 90) bridges across Berwick Bay were raised.

A.4.97. LA Hwy 129 (LA 87) Bridge (Charenton Canal). This bridge provides access across the Charenton drainage canal.

A.4.98. US 90 Bridge (Charenton Canal). This bridge also provides access across the Charenton drainage canal.

A.4.99. Texas and New Orleans Railroad Bridge (Charenton Canal). The Texas and New Orleans Railroad bridge provides access across the Charenton drainage canal.

A.4.100. Louisiana and Arkansas Railroad Bridge (Simmesport). This feature consists of lengthening the existing railroad bridge in conjunction with channel improvement dredging.

A.4.101. New Orleans, Texas and Mexico Railroad Bridge (Krotz Springs). This consists of lengthening the existing highway and railroad bridge in conjunction with channel improvement dredging.

A.4.102. US 90 Bridge (Wax Lake Outlet). This feature provided for construction of a new bridge for US Highway 90 over the dredged channel.

A.4.103. Southern Pacific Railroad Bridge (Wax Lake Outlet). This new bridge was constructed to carry the Southern Pacific line over the dredged channel.

A.4.104. LA Highway 1 (Morganza). This highway is supported on 3-foot-wide piers of the Morganza control structure. The earth embankment on each side of the control structure also serves to carry the highway across the floodway.

A.4.105. Texas Pacific Railroad Bridge (Morganza). This bridge is supported on 3-foot-wide piers of the control structure. The earth embankment on each side of the control structure also serves to carry the railroad bridge across the floodway.

A.4.106. Texas and Pacific Railroad, Readjustment of Line Between McKneely and Palmetto. This feature provides for high level crossing by adjustment of track and facilities.

A.4.107. Numerous Oil and Gas Pipelines, Powerlines, etc.

MAINTENANCE DREDGING

A.4.108. Maintenance dredging within the Atchafalaya Basin consists of dredging approximately 2,450,000 cubic yards per year. Dredging frequency, average yardage per dredging event, and disposal areas are shown in Table A-4-15.

MODIFICATIONS TO STRUCTURES

A.4.109. In addition to the necessary raising of levees and floodwalls due to increases in flowlines, some navigation and drainage structures associated with the project will also require modifications. These structures include the Bayou Sorrel, Bayou Boeuf, and Berwick locks; the Charenton and Calument floodgates; and drainage structures and pumping stations on the levees west of Berwick.

TABLE A-4-15

MAINTENANCE DREDGING

Location	Dredging Frequency	Average Cubic Yards per Dredging Event	Disposal Areas
Below Bayou Sorrel (GIWW Port Allen-Morgan City Route)	Annually	250,000	Confined on bank adjacent to waterway
Sixmile Lake	Once every 5 years	480,000	Disposed on bank adjacent to channel and in deep water of channel.
Berwick Bay Harbor	Annually	500,000	Disposed in deep water in Atchafalaya River
East Freshwater Distribution Channel	Once every 10 years	160,000	Confined on bank adjacent to waterway
E&W Access Channels	Once every 10 years	610,000	Confined on bank adjacent to waterway
Old River Lock Tailbay	Once every 10 years	7,000	Confined on bank adjacent to waterway
Berwick Lock Forebay	Once every 2 years	70,000	Disposed in deep water in Atchafalaya River and in shallow water adjacent to forebay
Three Rivers (mile 0)	Annually	150,000	In deep water of the Atchafalaya River
Below Bayou Sorrel (Alternate Route GIWW)	Annually	170,000	Confined on banks adjacent to waterway

OPERATION AND MAINTENANCE

A.4.110. The Federal Government is responsible for all operation and maintenance of the authorized project, except for those required of local interests, the State of Louisiana and the owners of utilities and transportation features relocated because of the project.

A.4.111. Local Interests. The responsibilities of local interests include routine maintenance of levees and floodwalls, including mowing and surveillance of levee conditions; operation, routine maintenance and minor repair of pumping stations; and operation and maintenance of all gravity drainage improvements associated with the East and West Atchafalaya Basin Protection Levees. Exceptions, which remain the responsibility of the Federal Government, are major repairs to pumping stations and the operation and maintenance of the drainage features listed below. Responsibility of the Federal Government for major repairs to the new Franklin pumping station and the Yokely pumping station are limited to a maximum of 55 percent and 45 percent of total costs, respectively. Drainage features are Bayou Darbonne drainage structure and channels, Bayou Courtableau drainage structure and channels, Bayou Courtableau diversion structures and channels, Charenton floodgate and drainage canal, and Bayou Boeuf-Bayou Long-Bayou Chene drainage canal.

A.4.112. State of Louisiana. The State of Louisiana, Department of Highways, is responsible for operating and maintaining all highway and highway bridge relocations and is also responsible for sharing in the operation and maintenance cost of the vertical lift bridge at Old River lock.

A.4.113. Others. The owners of other relocations (railroads, pipelines, powerlines, etc.) are responsible for their operation and maintenance.

Section 5 - EXISTING CONDITIONS (PROFILE)

A.5.1. The study area is comprised of three interrelated components: the Red River backwater area; the Atchafalaya Basin Floodway system; and the Lower Atchafalaya River complex (the Terrebonne Parish marshes and backwater area northeast of Morgan City), including Atchafalaya Bay (Figure A-5-1). Located in south central Louisiana, the study area is about 200 miles long (north to south) and averages 40 miles in width (east to west).

A.5.2. The northernmost portion of the study area, the Red River backwater area, is situated north of Old River and encompasses parts of Avoyelles, Caldwell, Catahoula, Concordia, Franklin, Grant, LaSalle, Ouachita, Rapides, Richland, and Tensas Parishes. This area is subject to overflow from backwater originating from the Mississippi River for about 40 miles westward to the hills beyond Catahoula Lake. From the head of the Atchafalaya Basin Floodway and the south bank levee of the Red River, the backwater area extends about 100 miles north along the Ouachita and Tensas Rivers and their tributaries to the limits of overflow in the vicinity of Monroe. This backwater area is currently protected from Mississippi River headwater flooding by the west bank Mississippi River levee. Portions of the area are protected from Ouachita River headwater flooding by the east bank Ouachita River levee and, to a minor extent, from headwater flooding by the Red River levees below Moncla. Additionally, many areas are protected from flooding by local levee systems.

A.5.3. The Atchafalaya Basin comprises the southern portion of the study area. It is bounded by alluvial ridges that mark the positions of the meander belts of ancient Mississippi River courses (Plate A-3). The Teche Ridge forms the western and southern boundaries while alluvial ridges along Bayou des Glaises, the Atchafalaya River (from its head to Simmesport), and Lower Old River define the basin on the north. The eastern boundary is formed by ridges along the Mississippi River, extending from the head of Old River to Donaldsonville and by ridges flanking Bayou Lafourche from Donaldsonville to Houma. At Houma, the Lafourche ridge is built over the Teche Ridge, completely inclosing the basin. The basin extends in a southerly direction for more than 100 miles from the latitude of Lower Old River and Bayou des Glaises to Atchafalaya Bay and the Gulf of Mexico. The basin contains the Atchafalaya Basin Floodway system, which is leveed to form the West Atchafalaya, Morganza, and Lower Atchafalaya Basin Floodways (Plate A-2). The floodway levees parallel the Atchafalaya River and confine an average width of 15 miles from Simmesport to Morgan City which encompasses approximately 822,000 acres. Also, the Atchafalaya River is leveed from Simmesport to below Krotz Springs. Below the river levees, the basin is a wetland of national significance.

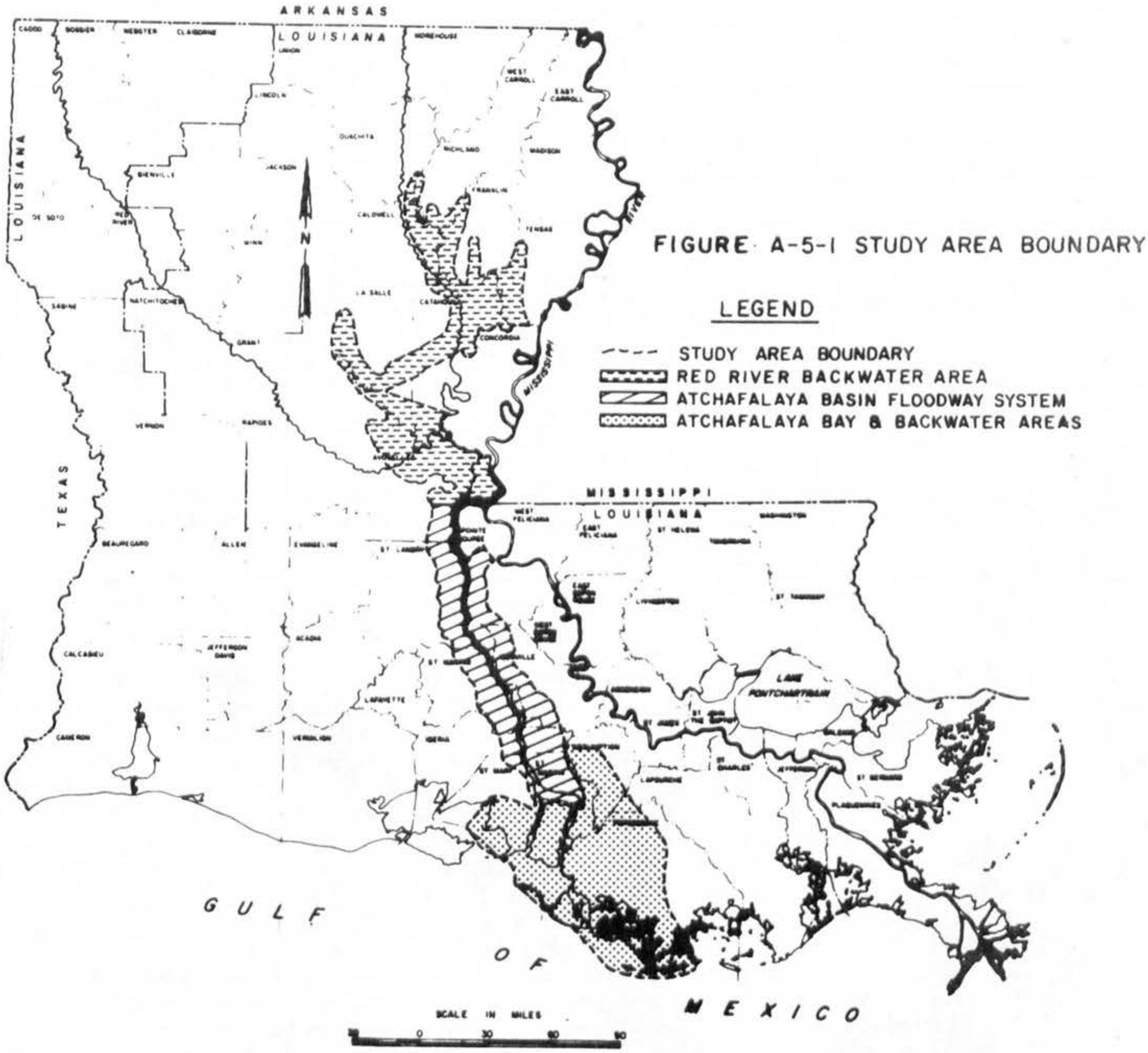

FIGURE A-5-1 STUDY AREA BOUNDARY
LEGEND
STUDY AREA BOUNDARY
RED RIVER BACKWATER AREA
ATCHAFALAYA BASIN FLOODWAY SYSTEM
ATCHAFALAYA BAY & BACKWATER AREAS
ARKANSAS
LOUISIANA
MISSISSIPPI
LOUISIANA
TEXAS
LOUISIANA
GULF OF MEXICO
MISSISSIPPI RIVER
LAKE PONTCHARTRAIN
SCALE IN MILES

A.5.4. The Lower Atchafalaya River backwater complex to the east of the lower side of the Lower Atchafalaya Basin Floodway covers an area of about 1,100,000 acres, extending from just south of Baton Rouge to the Gulf of Mexico. The area is roughly bounded on the east by the Texas and New Orleans Railroad and the Houma Navigation Channel and on the west by the Lower Atchafalaya Basin Floodway. Portions of Iberville, Assumption, St. Martin, Lafourche, and Terrebonne Parishes are located in this area.

Characteristics of the Mississippi and Atchafalaya Rivers

GENERAL

A.5.5. During the years in which the Atchafalaya River had developed from a minor distributary into one which threatened capture of the Mississippi River, the US Army Corps of Engineers has maintained records that document its enlargement. Evaluations of these data are in several reports among which are the Mississippi River Commission's "Atchafalaya River Study" (May 1951) and "The Mississippi and Atchafalaya Rivers Below Old River In Relation to Human Settlement: 1718-Present" by the Institute of River Studies, University of Missouri-Rolla (in publication). The following paragraphs are intended only as a summary of the principal hydraulic data on the Atchafalaya River.

LENGTH

A.5.6. The Atchafalaya distributary from its head at the junction of the Old River segment with the Mississippi River to Atchafalaya Bay is 141 miles in length. During most of the year it reaches approximate sea level at Atchafalaya Bay 135 miles below its head. In contrast, the length of the Mississippi River below Old River is 332 miles to the mouth of Southwest Pass and 301 miles to Head of Passes (approximate sea level).

SLOPE

A.5.7. The average water surface slope of the Atchafalaya River has become progressively flatter with time, but is still a much steeper slope than that of the Mississippi River. Plate A-4 is a plot of the water surface profile of the Atchafalaya River from Simmesport to

Morgan City for a discharge of 240,000 cfs. Stage data at locations throughout the basin are published yearly in the US Army Corps of Engineers "Stages and Discharges Publication."

DISCHARGE

A.5.8. Discharge observations made in the Atchafalaya River at Simmesport are generally representative of the flow in the Atchafalaya Basin. Measurements made in the Mississippi River at Tarbert Landing are representative of the flow in the Mississippi River to the gulf. Since 1903, observations at Simmesport have recorded a maximum of 781,000 cfs, a mean of 211,000 cfs, and a minimum of 10,500 cfs. A tabulation of the total annual discharges since 1951 is shown in Table A-5-1. At Tarbert Landing the maximum discharge is 1,977,000 cfs, the mean is 454,000 cfs, and the minimum is 85,000 cfs. Table A-5-1 contains a tabulation of the annual discharges since 1949. Since 1900, the percent of latitude discharge in the Atchafalaya River has increased from 15 to just over 30 percent (Plate A-5). The Old River control structure now maintains this distribution at 30 percent on an annual basis.

A.5.9. Discharge measurements made in the Old River outflow channel since 1963 have resulted in a maximum of 610,000 cfs and a mean of 157,000 cfs. Table A-5-1 contains a tabulation of the annual discharge since 1965.

A.5.10. Flows entering the Atchafalaya River from the Red River are represented by measurements made at Alexandria. Since 1928, maximum discharge has been 233,000 cfs, the mean 31,700 cfs, and the minimum 873 cfs. Table A-5-1 contains the annual discharges since 1951.

A.5.11. Since 1975, discharge measurements have been made at four ranges in the Atchafalaya Basin Floodway. The ranges give an indication of the discharge leaving the main channel via the four major distributaries: the East and West Access Channels and the East and West Freshwater Distribution Channels. These stations are not rated ranges and, therefore, annual discharges are not available.

A.5.12. Discharges have been observed intermittently since 1927 in the Lower Atchafalaya River at Morgan City and since 1946 in Wax Lake Outlet at Calumet. The ranges are located near the Gulf of Mexico and are, therefore, subject to tidal influences. Attempts have been unsuccessful in trying to rate these two stations. The distribution of flow between the outlets is currently (1980) about 70/30 percent (Lower Atchafalaya River/Wax Lake Outlet).

TABLE A-5-1
SUMMARY OF TOTAL ANNUAL DISCHARGES
AT POINTS INFLUENCING ATCHAFALAYA RIVER INFLOW

WATER YEAR (OCT-SEP)	WATER YEAR DISCHARGES (1,000 DSF)			
	ATCHAFALAYA RIVER 1/	MISSISSIPPI RIVER 2/	OLD RIVER OUTFLOW CHANNEL 3/	RED RIVER 4/
1949-50		245,000		
1950-51		225,000		
1951-52	80,800	201,000		8,500
1952-53	57,000	142,000		12,600
1953-54	32,000	89,000		5,900
1954-55	50,400	137,000		7,300
1955-56	49,100	127,000		4,400
1956-57	74,100	173,000		16,800
1957-58	89,400	196,000		18,500
1958-59	55,700	129,000		6,800
1959-60	69,300	164,000		9,800
1960-61	76,800	168,000		12,700
1961-62	88,900	191,000		12,500
1962-63	47,100	105,000		5,000
1963-64	33,100	125,000		4,200
1964-65	66,400	150,000		6,800
1965-66	51,000	138,000	32,500	8,000
1966-67	57,300	132,000	45,000	6,800
1967-68	80,100	163,000	52,200	16,200
1968-69	83,300	168,000	59,300	14,800
1969-70	74,300	151,000	59,600	8,700
1970-71	71,700	148,000	56,400	4,900
1971-72	75,400	151,000	59,400	7,800
1972-73	140,000	266,000	102,000	17,900
1973-74	117,000	231,000	78,000	18,000
1974-75	117,000	204,000	70,500	22,500
1975-76	65,900	145,000	49,700	6,200
1976-77	47,800	113,000	30,600	8,500
1977-78	79,700	185,000	62,300	4,900
1978-79	104,800	244,000	67,800	13,100
AVERAGE	72,700	167,000	58,900	10,400

1/ At Simmesport, Louisiana.
2/ At Tarbert Landing, Mississippi.
3/ Near Knox Landing, Louisiana.
4/ At Alexandria, Louisiana.

CHANNEL WIDTH AND DEPTH

A.5.13. The increase in discharge through the Atchafalaya River is coupled with a corresponding increase in channel widths (Figures A-5-2 and A-5-3). Data also show a gradual increase through the years together with a smoothing out of some of the major irregularities in the channel bottom. The river channel decreases in area at the ends of the levees and is even more shallow in the Grand Lake-Sixmile Lake segment. South of Sixmile Lake, depths increase in the Lower Atchafalaya River, but become less as the river enters Bateman Lake and Atchafalaya Bay.

A.5.14. Channel widths in the Atchafalaya River have increased so that some areas show a channel width double that of 50 years ago. This trend of enlargement manifests itself along many reaches of the river by caving of opposite banks, a condition not observed on the Mississippi River where caving along an individual reach is usually confined to a single bank. Changes in channel area below the Low Water Reference Plane (LWRP) are shown in Figures A-5-4 and A-5-5 for the Atchafalaya River. Changes in channel widths and areas for the Mississippi River are shown in Figures A-5-6 through A-5-9.

Geology and Soils

FIELD INVESTIGATIONS

A.5.15. No soil borings were made specifically for this study of the Lower Atchafalaya Basin Floodway nor were any specific geologic field studies conducted. However, existing geologic publications, GDM's, boring data, and other available soils information from previous studies were reviewed for greater insight into geologic conditions to be encountered at the proposed and completed project sites within the Lower Atchafalaya Basin Floodway.

GENERAL SURFACE AND SUBSURFACE GEOLOGY

A.5.16. The general surface geology of the Atchafalaya Basin and a generalized geologic section taken eastward across the floodway from Franklin shows typical subsurface conditions encountered (Plates A-6 and A-7). That portion of the floodway north of the Teche Ridge is primarily a backswamp area deposited by overflow from various stream courses that have traversed the general area. However, from the vicinity of Krotz Springs southward, the backswamp deposits are covered by deltaic materials up to 25 feet in depth. Also, many

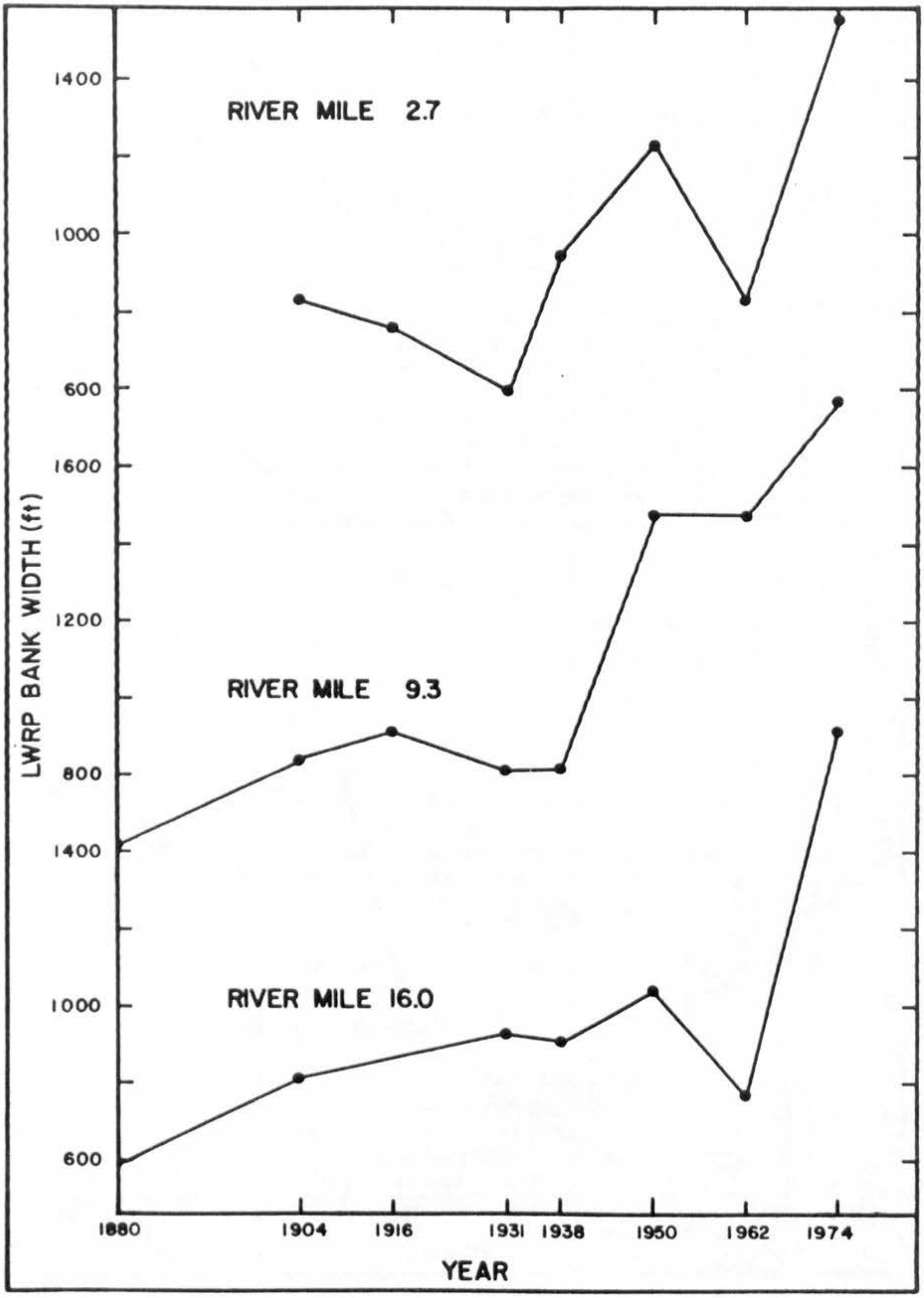

FIGURE A-5-2. LWRP bank widths of the Atchafalaya River at river miles 2.7, 9.3 and 16.0 between 1880 and 1974.

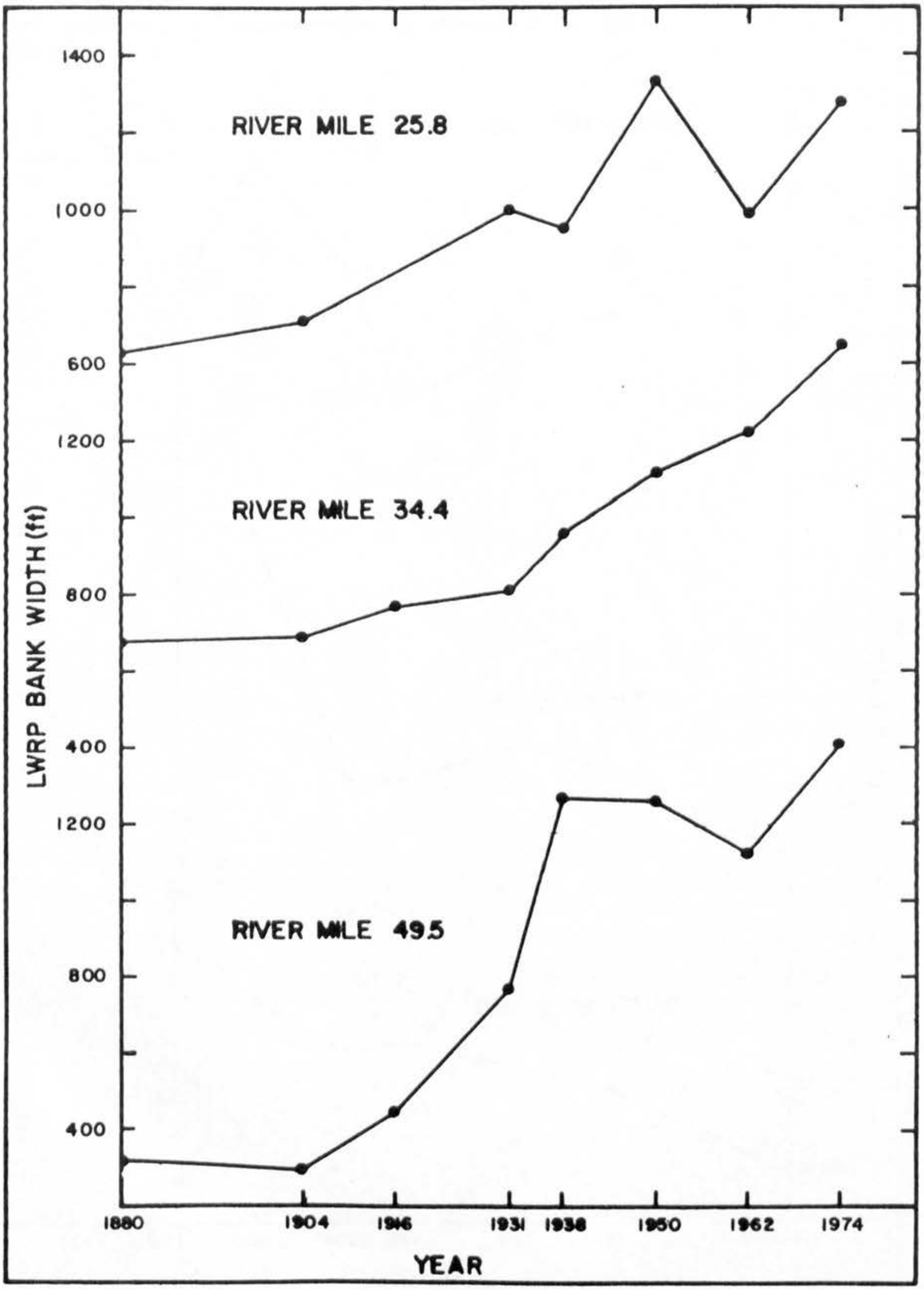

FIGURE A-5-3. LWRP bank widths of the Atchafalaya River at river miles 25.8, 34.4 and 49.5 between 1880 and 1974.

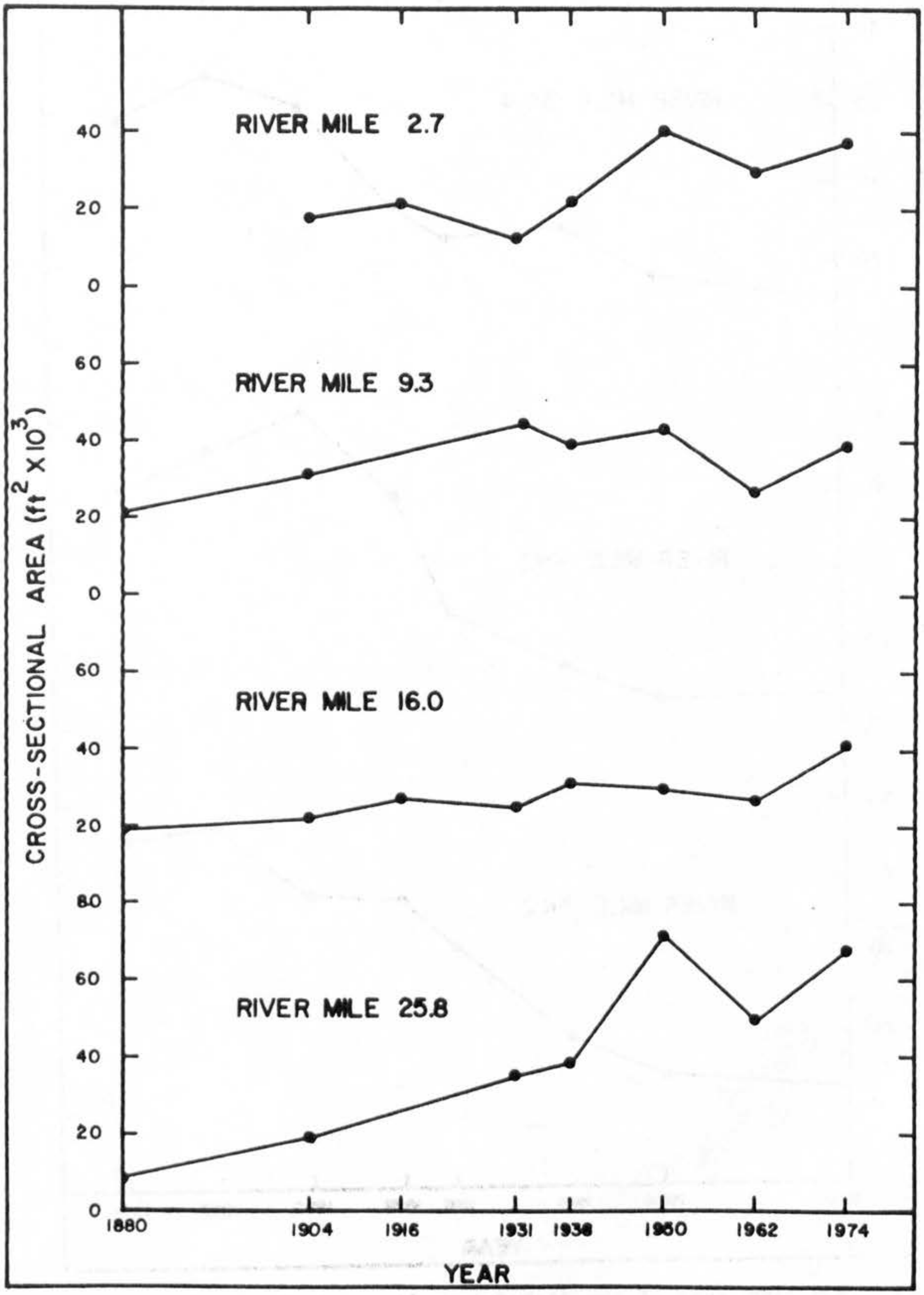

FIGURE A-5-4. LWRP area of the Atchafalaya River at river miles 2.7, 9.3, 16.0 and 25.8 between 1880 and 1974.

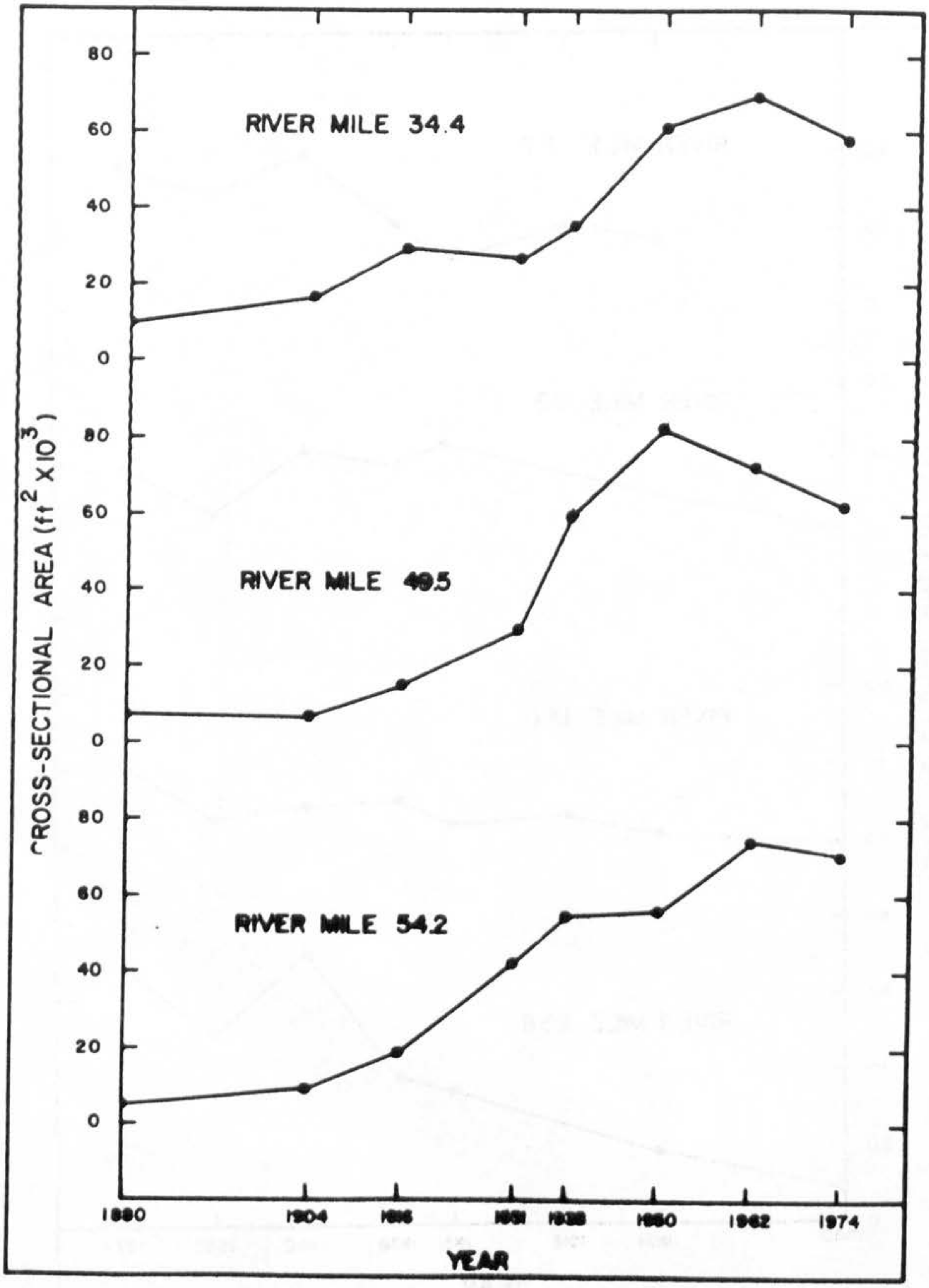

FIGURE A-5-5. LWRP area of the Atchafalaya River at river miles 34.4, 49.4 and 54.2 between 1880 and 1974.

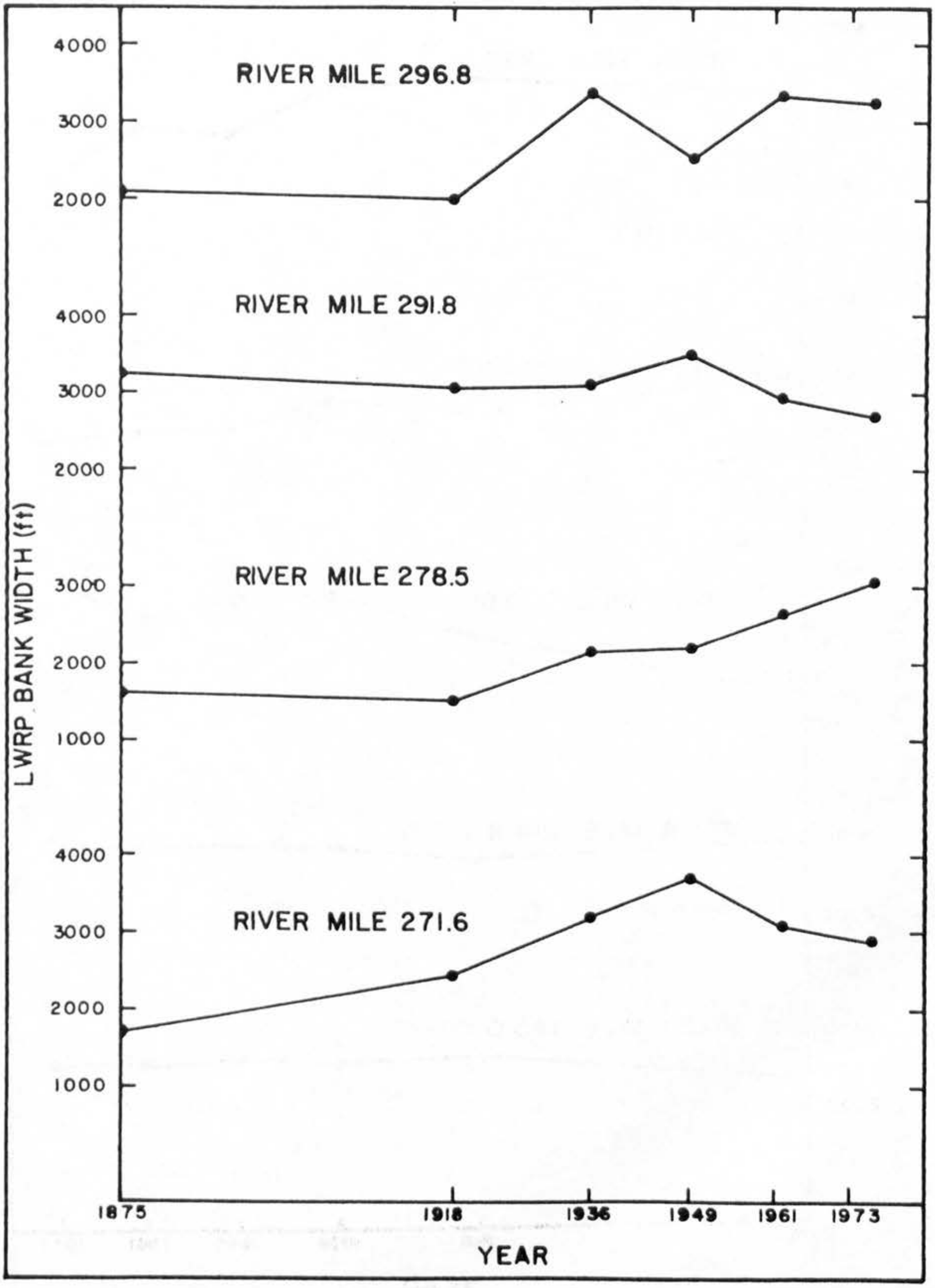

FIGURE A-5-6. LWRP bank widths of the Mississippi River at river miles 296.8, 291.8, 278.5 and 271.6 between 1875 and 1974.

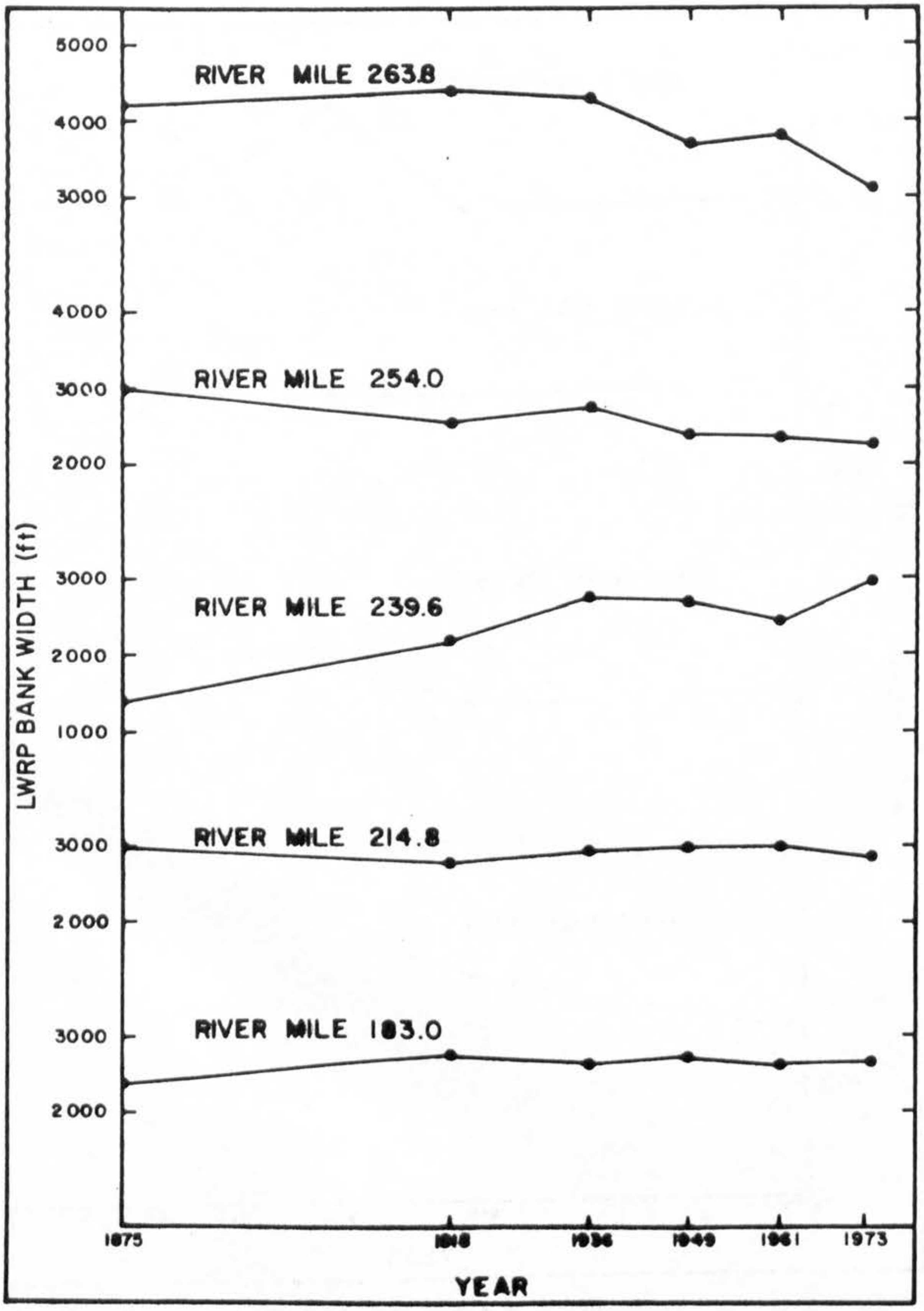

FIGURE A-5-7. LWRP bank widths of the Mississippi River at river miles 263.8, 254.0, 239.6, 214.8 and 183.0 between 1875 and 1974.

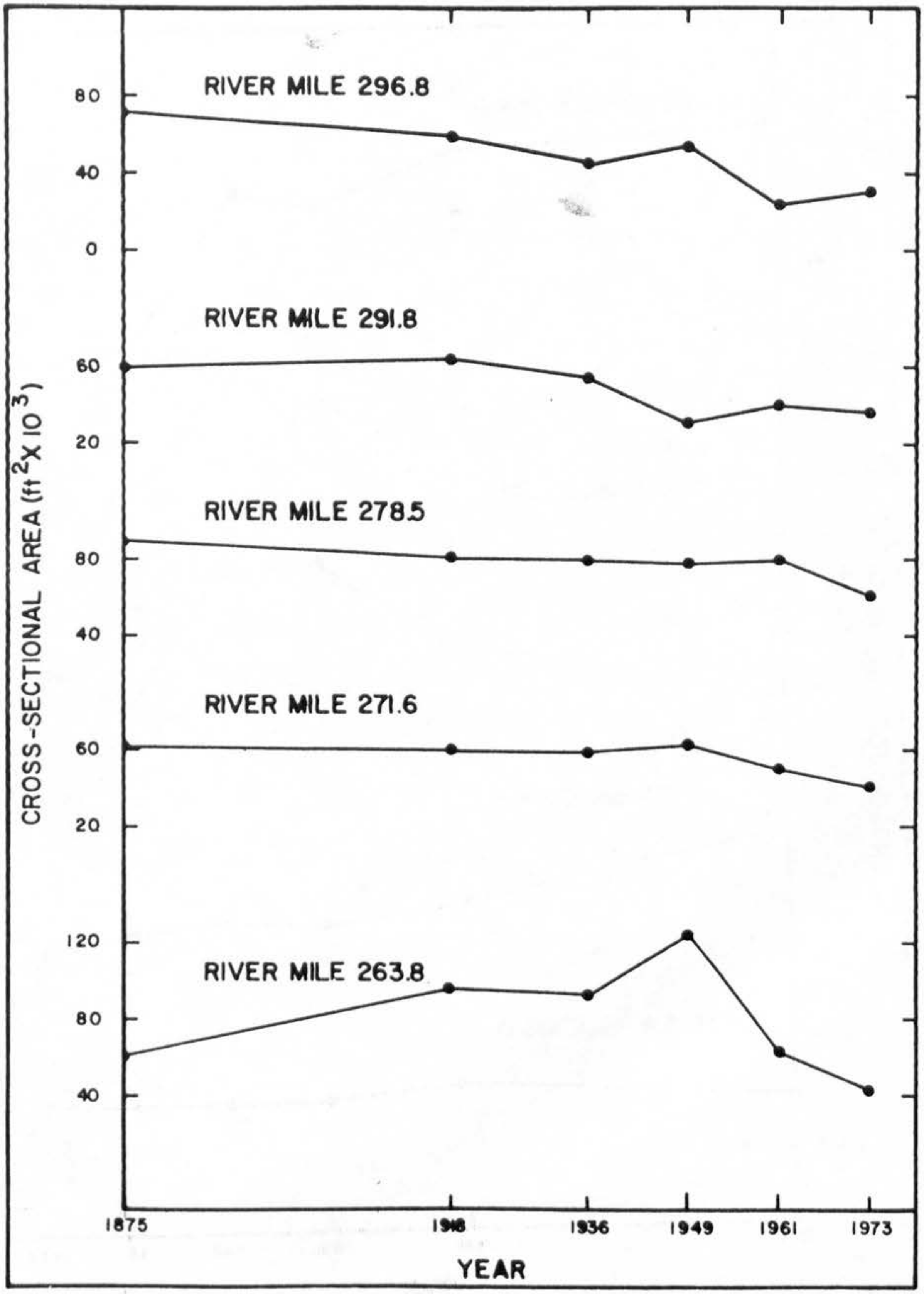

FIGURE A-5-8. LWRP area of the Mississippi River at river miles 296.8, 291.8, 278.5, 271.6 and 263.8 between 1875 and 1974.

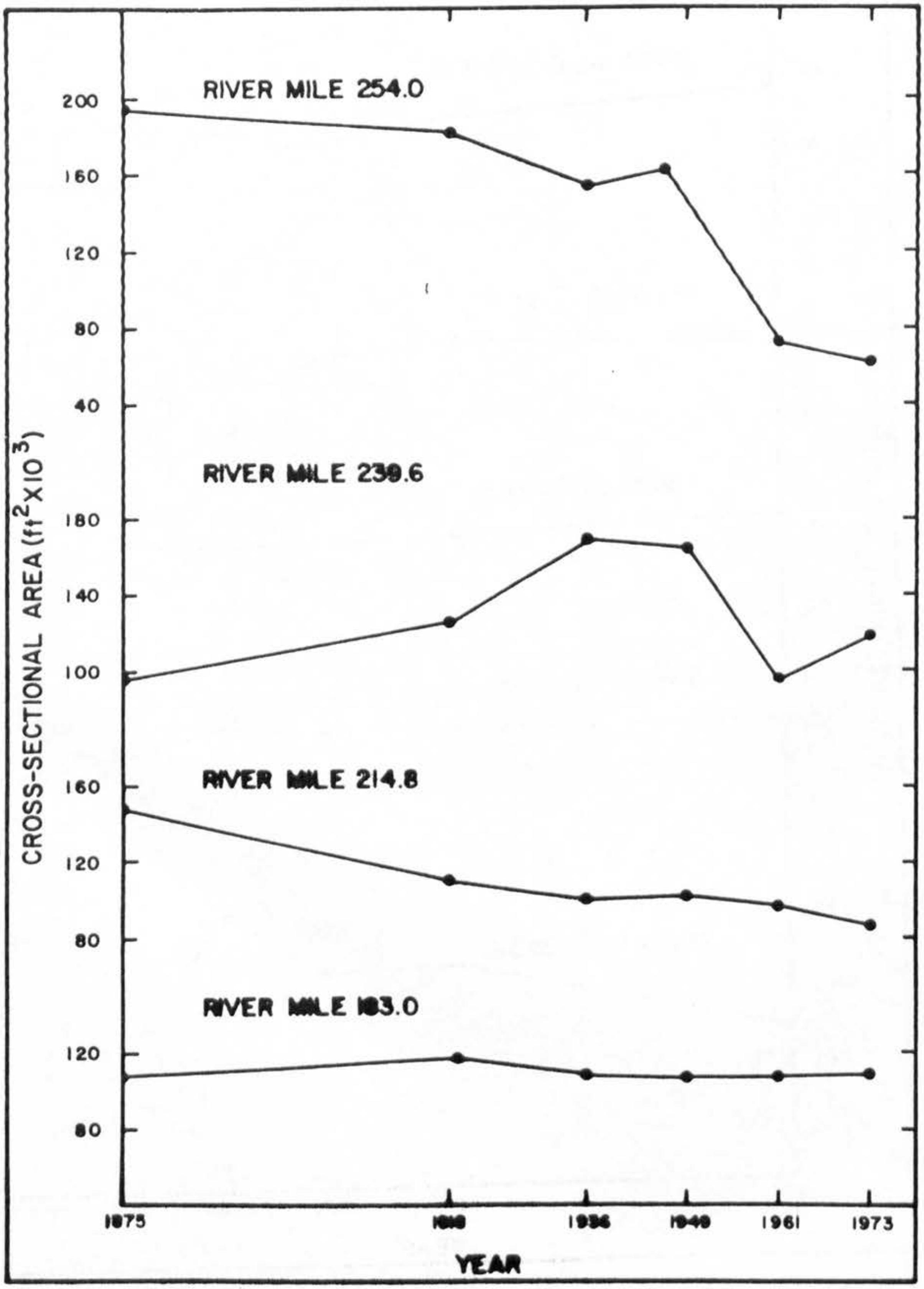

FIGURE A-5-9. LWRP area of the Mississippi River at river miles 254.0, 239.6, 214.8 and 183.0 between 1875 and 1974.

narrow areas of point bar and channel fill deposits are found where old channels established their meander belts.

A.5.17. At the northern end of the study area, along the lower Red River to the general vicinity of Simmesport, Holocene deposits are underlain directly by Tertiary age deposits of the Miocene series. From this point southward to the general vicinity of Melville, undifferentiated Pliocene-Miocene series deposits underlie the Holocene materials in a narrow east-west band across the basin. From Melville southward to the gulf, the Holocene is underlain by Pleistocene deposits that outcrop at the surface and flank each side of the Holocene alluvial valley to the latitude of Donaldsonville on the east and to Franklin to the west.

GEOLOGIC AND RELATED PROBLEMS (PAST, EXISTING, AND POTENTIAL)

A.5.18. One of the initial problems in using the Atchafalaya Basin as an efficient floodway was the need to improve the flow capacity of the lower basin by establishing one major low water channel. Dredging operations were initially conducted in 1932 for this purpose. This partially dredged channel is still developing as the overbank areas build up by sedimentation during high water flows.

A.5.19. As flow through the basin increased, the channel has enlarged to a sizable navigation and floodflow channel. The result was a notable increase in diversion of flow from the Mississippi River to the Atchafalaya River, because this route is considerably shorter to the gulf and has a distinct gradient advantage. By 1950 the rate of annual diversion from the Mississippi River was approaching 25 percent and by projecting a curve of annual diversion rates, it was found that by 1971, 40 percent of the Mississippi River flow would be diverted to the Atchafalaya River. The problem of diversion was initially solved by construction of the Old River control structure to enable flow control between the Mississippi and Atchafalaya Rivers.

A.5.20. Other than damage incurred by the Old River low sill structure during the 1973 flood, the major problems in maintaining the floodway and completing the necessary levees, structures, channels, and other features from a geologic viewpoint are subsidence, sedimentation, and river elongation due to delta development. These geologic processes are still occurring as they have in the past. Increased sedimentation actually accelerates subsidence; the sedimentation effects of recent floods are visible immediately after floodwaters pass to the gulf. Regional subsidence occurs somewhat more slowly as sedimentation increases. River elongation increases the height of the flowline within the lower portions of the project area.

A.5.21. Changes in water levels over time have been observed along the Louisiana gulf coast. The changes, called apparent sea level rise, are the result of true sea level rise and land subsidence caused by basement sinking from the sediment load, consolidation of sediments of the gulf coast geosyncline, local consolidation, and tectonic activity. In the area of the Atchafalaya delta, the water levels are very much affected by the deltaic activity incident to the maturation of the Atchafalaya River. The effect of true sea level rise is difficult to evaluate, but is generally considered to be less than 0.2-foot per century. It is likewise difficult in the Atchafalaya delta to determine how the apparent change in sea level is distributed between subsidence and increased hydraulic gradient. Subsidence rates vary considerably with geologic time, and changes caused by deltaic activity are dependent on the hydrologic conditions in the Atchafalaya delta. The rate of change in apparent sea level can vary between 0 and 3 feet per century, depending on the location considered and the method used to determine the rate. Based on geologic investigations subsidence is greatest along the coastline with the rate decreasing with distance inland. The rates determined by geologic methods are generally less than those determined by recent methods which use statistical analysis of water surface elevations. The latter methods ignore the fact that change in the hydraulic characteristics of the system affects the stages.

LOCAL SETTLEMENT

A.5.22. Settlement of the earth levees constructed in the basin in some reaches has exceeded 20 feet. The near-surface portion of the backswamp deposits, which form the foundation for most of the protection levee system, are highly compressible. Some areas contain thick deposits of peat, decayed wood, and highly organic clays with water contents greater than 200 percent by volume not unusual. These clays consolidate tremendously under loading as water is squeezed from them, and when loaded too severely, will fail. Soil profiles and settlement data for the large protection levees are shown in Plates A-8 through A-11. These data delineate the areas where foundation soils are poorest and settlement has been most severe.

Sediment

A.5.23. Regular suspended sediment and bed material measurements have been made on the Mississippi, Red, and Atchafalaya Rivers since 1949. Measurements have been made on the Old River outflow channel since 1965. Bed material measurements, other than at the suspended sediment sampling ranges, were made infrequently prior to 1971. Sediment measurements made in 1929 and 1932 similar to the recent

measurements have been published in "Paper H" and "Paper U" of the US Waterways Experiment Station. Measurements made since 1950 are available but unpublished. Summaries of the annual sediment loads are presented in Tables A-5-2 through A-5-5. Since 1950, measurements in the Mississippi River at Tarbert Landing have recorded a maximum of 3,740,000 tons/day; a mean of 218,000 tons/day; and a minimum of 20,000 tons/day. Measurements in the Atchafalaya River at Simmesport since 1951 have recorded a maximum suspended load of 2,120,000 tons/day; a mean of 108,000 tons/day; and a minimum of 2,100 tons/day. Old River sediment loads measured near Knox Landing since 1965 have been recorded to be 82,700 tons/day maximum; 52,500, average; and 19,300, minimum. Since 1951, measurements in the Red River at Alexandria have recorded a maximum suspended load of 2,020,000 tons/day; a mean of 36,500 tons/day; and a minimum of 220 tons/day. Measurements have been made since 1975 at the four main distributaries in the Atchafalaya Basin Floodway. The ranges of the east and west access channels and the east and west freshwater distribution channels are not rated but are used to indicate the amount of sediment leaving the main channel.

Climatology

TEMPERATURE

A.5.24. Lower Basin. Records for seven stations located in or adjacent to the lower basin (Donaldsonville, Houma, Morgan City, Paincourtville, Plaquemine, Schriever, and Thibodaux) were obtained from "Climatological Data" for Louisiana published by the National Weather Service. The minimum temperature of 3 degrees Fahrenheit (°F) was recorded at Donaldsonville on 13 February 1899. The maximum temperature of 105°F occurred at Schriever on 18 August 1909. The seasonal normal temperatures vary from 56°F in winter to 82°F in summer. Temperature normals for the stations in Donaldsonville, Houma, and Morgan City indicate that the average annual temperature is 69°F. Normal monthly temperatures in degrees Fahrenheit are given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
54.4	57.0	62.0	69.0	75.8	80.8	82.2	82.1	78.7	70.5	61.2	56.2

A.5.25. Upper Basin. The annual normal temperature for this area is 68°F and the recorded extremes for Melville are 5°F, 13 February 1899, and 105°F, 9 August 1935. Seasonal normal temperatures range from 53°F in winter to about 81°F in summer. The normal monthly temperatures are given below (based on readings taken at Melville, Louisiana).

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
51.8	54.6	60.1	68.3	74.4	79.9	81.7	81.4	77.0	68.0	58.9	53.6

TABLE A-5-2

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
LOWER MISSISSIPPI RIVER AT TARBERT LANDING, MISSISSIPPI 1/

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	SILT RATIO 2/ (%)	Silt (in 1,000 tons)	(%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1949-50	548,000	108,000	20	440,000	80	245,000	828
1950-51	575,000	67,000	12	508,000	88	225,000	947
1951-52	408,000	74,000	18	334,000	82	201,000	754
1952-53	212,000	29,000	14	183,000	86	142,000	552
1953-54	108,000	14,000	13	94,000	87	89,000	449
1954-55	211,000	40,000	19	171,000	81	137,000	570
1955-56	161,000	26,000	16	135,000	84	127,000	468
1956-57	291,000	53,000	18	238,000	82	173,000	624
1957-58	326,000	95,000	29	231,000	71	196,000	616
1958-59	231,000	79,000	34	152,000	66	129,000	660
1959-60	318,000	77,000	24	241,000	76	164,000	718
1960-61	231,000	71,000	31	160,000	69	168,000	510
1961-62	264,000	94,000	36	170,000	64	191,000	512
1962-63	101,000	24,000	24	77,000	76	105,000	353
1963-64	121,000	18,000	15	103,000	85	125,000	361
1964-65	203,000	41,000	20	162,000	80	150,000	502
1965-66	174,000	46,000	26	128,000	74	138,000	469
1966-67	111,000	15,000	14	96,000	86	132,000	312
1967-68	155,000	36,000	23	119,000	77	163,000	353
1968-69	155,000	39,000	25	116,000	75	168,000	343
1969-70	149,000	49,000	33	100,000	67	151,000	364
1970-71	181,000	75,000	41	106,000	59	148,000	456
1971-72	152,000	48,000	32	134,000	68	151,000	373
1972-73	227,000	75,000	33	152,000	67	266,000	316
1973-74	197,000	48,000	24	149,000	76	231,000	316
1974-75	164,000	40,000	24	124,000	76	204,000	300
1975-76	115,000	20,000	18	95,000	82	145,000	294
1976-77	81,000	10,000	12	71,000	88	113,000	265
1977-78	173,000	34,000	20	139,000	80	185,000	340
1978-79	194,000	54,000	28	140,000	72	244,000	295
Average	218,000	50,000	23	168,000	77	167,000	484

1/ Sampling at Baton Rouge before Mar 1958 and at Red River Landing between Mar 1958 and June 1963.

2/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction included all of the fine material passing the No. 230 sieve.

TABLE A-5-3

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
ATCHAFALAYA RIVER AT SIMMESPORT, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	SILT (%)	RATIO 1/ Silt (in 1,000 tons)	(%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1951-52	196,000	49,000	25	147,000	75	80,800	900
1952-53	135,000	28,000	21	107,000	79	57,000	880
1953-54	54,100	13,000	24	41,000	76	32,000	627
1954-55	93,400	24,100	26	69,300	74	50,400	686
1955-56	67,200	15,500	23	51,700	77	49,100	507
1956-57	225,000	55,000	25	170,000	75	74,100	1,126
1957-58	214,000	48,000	22	166,000	78	89,400	887
1958-59	83,200	20,900	25	62,300	75	55,700	553
1959-60	132,000	24,000	18	108,000	82	69,300	704
1960-61	133,000	40,000	30	93,000	70	76,800	643
1961-62	152,000	58,000	38	94,000	62	88,900	633
1962-63	44,900	8,600	19	36,300	81	47,100	353
1963-64	52,600	10,400	20	42,200	80	33,100	588
1964-65	109,000	28,000	25	81,000	75	66,400	607
1965-66	88,500	17,500	20	71,000	80	51,000	642
1966-67	55,700	6,800	12	48,900	88	57,300	360
1967-68	121,000	16,000	14	105,000	86	80,100	561
1968-69	115,000	27,000	24	88,000	76	83,300	512
1969-70	75,100	19,800	26	55,300	74	74,300	374
1970-71	72,400	19,600	27	52,800	73	71,700	374
1971-72	89,600	18,700	21	70,900	79	75,400	440
1972-73	124,000	45,000	36	79,000	64	140,000	329
1973-74	143,000	32,000	23	111,000	77	117,000	453
1974-75	158,000	35,000	22	123,000	78	117,000	499
1975-76	56,100	8,500	15	47,600	85	65,900	315
1976-77	57,100	6,000	11	51,100	89	47,800	443
1977-78	71,200	12,500	18	58,700	82	79,700	331
1978-79	112,300	25,500	23	86,800	77	104,800	346
Average	108,000	25,000	23	83,000	77	72,700	550

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all of the fine material passing the No. 230 sieve.

TABLE A-5-4

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
OLD RIVER OUTFLOW CHANNEL NEAR KNOX LANDING, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND SILT RATIO 1/				Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
		Sand (in 1,000 tons)	(%)	Silt (in 1,000 tons)	(%)		
1965-66	33,100	5,900	18	27,200	82	32,500	378
1966-67	37,300	8,300	22	29,000	78	45,000	307
1967-68	49,900	13,000	26	36,800	74	52,200	354
1968-69	62,900	14,100	22	48,800	78	59,300	393
1969-70	63,000	15,700	25	47,300	75	59,600	414
1970-71	70,500	24,100	34	46,400	66	56,400	438
1971-72	56,800	16,700	29	40,100	71	59,400	355
1972-73	82,700	25,800	31	56,900	69	102,000	301
1973-74	60,900	16,300	27	44,500	73	78,000	289
1974-75	50,000	10,100	20	39,900	80	70,500	262
1975-76	34,800	6,000	17	28,800	83	49,700	259
1976-77	19,300	1,400	7	17,900	93	30,600	234
1977-78	62,600	14,600	23	48,000	77	62,300	372
1978-79	51,200	9,700	19	41,500	81	67,800	280
Average	52,500	13,000	25	39,600	75	58,900	330

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all the fine material passing the No. 230 sieve.

TABLE A-5-5

SUMMARY OF MEASURED SUSPENDED SEDIMENT LOADS
RED RIVER AT ALEXANDRIA, LOUISIANA

Water Year (Oct-Sep)	Total Measure Sed. Load (in 1,000 tons)	SAND Sand (in 1,000 tons)	SILT RATIO 1/ (%)	Silt (in 1,000 tons)	(%)	Water Year Discharge (1,000 DSF)	Avg.Sed. Conc. (in ppm)
1951-52	39,600	6,500	16	33,100	84	8,500	1,730
1952-53	43,800	11,900	27	31,900	73	12,600	1,290
1953-54	16,500	3,100	19	13,400	81	5,900	1,030
1954-55	21,800	3,600	16	18,200	84	7,300	1,100
1955-56	13,400	2,200	17	11,200	83	4,400	1,130
1956-57	82,400	17,000	21	65,400	79	16,800	1,820
1957-58	95,600	15,300	16	80,300	84	18,500	1,910
1958-59	13,600	4,200	31	9,400	69	6,800	730
1959-60	31,900	6,200	20	25,700	80	9,800	1,200
1960-61	47,000	12,200	26	34,800	74	12,700	1,360
1961-62	45,600	10,900	24	34,700	76	12,500	1,350
1962-63	9,800	2,600	26	7,200	74	5,000	730
1963-64	10,600	1,500	14	9,100	86	4,200	940
1964-65	23,100	4,000	18	19,100	82	6,800	1,250
1965-66	29,700	6,200	21	23,500	79	8,000	1,370
1966-67	16,200	3,200	20	13,000	80	6,800	880
1967-68	71,200	16,400	23	54,800	77	16,200	1,630
1968-69	64,200	16,700	26	47,500	74	14,800	1,610
1969-70	28,200	8,200	29	20,000	71	8,700	1,200
1970-71	6,600	2,200	33	4,400	67	4,900	500
1971-72	34,900	6,700	19	28,200	81	7,800	1,670
1972-73	52,300	13,000	25	39,300	75	17,900	1,080
1973-74	77,000	19,900	26	57,100	74	18,000	1,580
1974-75	81,400	16,900	21	64,500	79	22,500	1,340
1975-76	7,400	1,100	15	6,300	85	6,200	442
1976-77	20,100	2,200	11	17,900	89	8,500	876
1977-78	8,600	2,200	26	6,400	74	4,900	650
1978-79	28,800	4,800	17	24,000	83	13,100	811
Average	36,500	7,900	22	28,600	78	10,400	1,300

1/ The sand fraction is the material retained on the No. 230 sieve (0.062 mm). The silt fraction includes all of the fine material passing the No. 230 sieve.

PRECIPITATION

A.5.26. Lower Basin. Records of eight stations located in or adjacent to the watershed were obtained from "Climatological Data" for Louisiana published by the National Weather Service. The maximum daily rainfall of 14.5 inches was recorded at Donaldsonville on 25 August 1926. The maximum monthly rainfall of 22.7 inches occurred at Morgan City in September 1943. All stations recorded months with no measurable rainfall, the most recent being Donaldsonville, Houma, Morgan City, and Schriever in October 1963. The maximum annual rainfall of 111.3 inches occurred at Morgan City in 1946, and the minimum of 33.0 inches was recorded at Houma in 1899. Precipitation normals for the stations at Carville, Houma, and Morgan City, indicate that the average annual rainfall is 62 inches. The mean monthly rainfall is given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
4.5	4.8	4.9	4.4	4.8	5.7	7.7	6.5	6.6	3.2	4.0	5.2

A.5.27. An intense thunderstorm produced the greatest rainfall of record, 15.6 inches at Morgan City, 16-17 April 1927. Other storms produced heavy rainfall amounts as follows: 7.4 inches on 24 April 1900; 8.0 inches, 8 October 1905; 7.3 inches, 18 April 1914; 6.7 inches, 15 April 1927; 9.7 inches, 18-19 September 1943; 6.1 inches, 29 March 1949; 5.4 inches, 8 June 1959; and 4.4 inches, 6 September 1967. In addition, hurricanes have produced rainfall as follows: 8.5 inches (estimated) on 30 September 1915; 8.0 inches, 25 August 1926; 4.9 inches, 2 October 1937; 6.5 inches, 7 August 1964; and 5.6 inches, 10 September 1965.

A.5.28. Upper Basin. Based on records from the National Weather Service at Simmesport and Melville, the normal annual precipitation is 57 inches. Normal monthly rainfall ranges from 3.1 inches in October to 5.9 inches in December. Monthly normals are given below.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5.4	5.1	5.5	5.3	5.7	4.4	5.0	4.1	3.8	3.1	4.1	5.9

A.5.29. The maximum monthly and annual rainfall for this area is 29.52 inches (May 1953) and 82.98 inches (1961), respectively. The minimum monthly and annual rainfall for the area is 0.0 inches (October 1963) and 33.3 inches (1924), respectively.

EVAPORATION

A.5.30. Measures of evaporation have been collected at Rice Experiment Station, Crowley, Louisiana, for the period 1910-1949.

During this period the annual evaporation varied from a maximum of 66.5 inches to a minimum of 41.6 inches. Monthly evaporation showed a maximum of 8 inches in July-August 1947 and a minimum of 1.4 inches in January 1911. The average monthly evaporation in inches is as follows.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2.3	2.7	3.8	4.8	6.0	6.2	5.9	5.8	5.2	4.5	3.0	2.4

A.5.31. In addition to the summaries given above for the lower and upper portions of the basin, the following summary is for the major lakes in the area.

Lake	Annual Precipitation	Lake Evaporation
Cocodrie	62 inches	48 inches
Fausse Pointe	60 inches	50 inches
Grand, Sixmile, and Flat	66 inches	49 inches
Opelousas Bay (Henderson)	58 inches	49 inches
Palourde	66 inches	49 inches
Verret	66 inches	49 inches

Biological Resources

A.5.32. Since the majority of the actions considered in this document are concentrated in the Lower Atchafalaya Floodway, the backwater area northeast of Morgan City, and the coastal marshes, the following discussions will focus on these areas and briefly address the other features of the project. The presentation discusses terrestrial and aquatic resources in terms of the flora, fauna, and ecological relationships which exist for each of the major land-use types situated in the area. This approach was chosen because of the vastness of the region and the consequential diversity of topographic, edaphic, and biotic characteristics encountered.

A.5.33. Historically, the higher alluvial flood plains of the northern portions of the project area have supported extensive stands of bottomland hardwoods. These forests are composed of several vegetative associations due to varied and complex soil and moisture conditions. Flood control measures and increased prices for farm products have induced conversion of bottomland hardwood forests into agricultural lands. Croplands, pastures, and levees form a major habitat type in the project area. In the southern portion of the project area and in the backwater area northeast of Morgan City, cypress-tupelo communities are present in low-lying areas subject to a prolonged hydroperiod (period of inundation). Extensive coastal

marshes border the project area along the Gulf of Mexico. In the natural process of river and flood plain development, these vegetative types encroach gulfward as deposition of sediment increases elevations and extends delta formation downstream, and river channel enlargement lowers water levels upstream. The other significant vegetative type in the project area, early successional bottomland hardwoods, predominates on newly accreted lands. This forest serves as a transition stage which, with time and increases in land elevation, will succeed to mature bottomland hardwoods. Table A-5-6 shows the major terrestrial habitat types in the project area and the acreage of each for the specified locations.

A.5.34. Aquatic systems of the project area are as diverse as the terrestrial. In the upper reaches of the area where river levees prevent annual overflow, the streams, bayous, and lakes are generally dependent on rainfall or backwater induced by flood stages in the lower portion of the area. Habitat diversity and productivity increase in areas to the south where there is overbank flooding and in the coastal marshes. Table A-5-7 exhibits aquatic habitat types and the acreage of each for the locations indicated.

A.5.35. The project area is dynamic. Natural and man-induced factors make it a continually changing system. As the Atchafalaya River main channel matures, areas which were previously overflowed at frequent intervals become less subject to overbank flows as a result of sedimentation and stage reduction. These processes and the activities of man have effected changes which keep the aquatic ecosystem transitory. System modifications which have contributed significantly to this dynamic state are clearing for agriculture, mineral exploitation, commercial forestry, flood control, and navigation programs.

A.5.36. In addition to describing the terrestrial and aquatic resources that are present in the project area, the discussions include a comparison of the relative value of the various habitat types as reflected by the USFWS Habitat Evaluation Procedures (HEP) and the US Army Corps of Engineers Habitat Evaluation System (HES). Plates A-12, A-13 and A-14 delineate existing land uses for the study area below the latitude of Krotz Springs.

Terrestrial Resources

EARLY SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.5.37. General. Approximately 93,900 acres of early successional bottomland hardwood forests exist in the project area; 91,200 acres

TABLE A-5-6

EXISTING TERRESTRIAL HABITAT

Habitat Type	1975 ACRES: Red River Backwater Area	1975 ACRES: West Atchafalaya Floodway	1975 ACRES: Simmesport, Melville, and Krotz Springs	1975 ACRES: Morganza Floodway	1980 ACRES: Lower Atchafalaya Basin Floodway [1]	1980 ACRES: Areas Outside the Floodway System [2]	Total
Mid-to-Late-Successional Bottomland Hardwood Forest	391,000	108,000	--	39,000	247,000	85,000	870,000
Cypress-Tupelo Swamp	29,000	--	--	1,000	176,000	275,000	481,000
Early Successional Bottomland Hardwood Forest	--	--	--	--	91,200	2,700	93,900
Early Successional Bottomland Hardwood Forest Mixed with Cypress-Tupelo	--	--	--	--	8,400	--	8,400
Cleared Land	354,000	60,000	--	17,000	16,400	80,800	528,200
Fresh Marsh	--	--	--	--	--	323,000	323,000
Brackish Marsh	--	--	--	--	--	89,400	89,400
Saline Marsh	--	--	--	--	--	108,000	108,000
Urban	1,000	--	2,000	--	--	5,300	8,300
Active Delta	--	--	--	--	--	10,100	10,100
TOTAL	775,000	168,000	2,000	57,000	539,000	979,300	2,520,300

[1] Includes the area bounded by a line one-quarter mile west of the WABPL north of Verdunville and a line one-quarter mile east of the EABPL north of Bayou Sorrel.

[2] Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

TABLE A-5-7

EXISTING AQUATIC HABITAT (1980 ACRES)

Habitat Type	1975 ACRES				1980 ACRES		
	Red River Backwater Area	West Atchafalaya Floodway	Simmesport, Melville, and Krotz Springs	Morganza Floodway	Lower Atchafalaya Basin Floodway [1/]	Areas Outside the Floodway System [2/]	Total
Riverine, Distributary, or Open-ended Canal	27,000	--	--	--	23,000	8,100	58,100
Freshwater Bayou or Slow-flowing Canal	12,000	1,000	--	--	15,900	22,100	51,000
Headwater Lake	--	--	--	--	18,200	--	18,200
Backwater Lake	36,000	1,000	--	--	13,800	28,200	79,000
Cropland Lake	6,000	--	--	--	--	--	6,000
Fresh Marsh Pond and Lake	--	--	--	--	--	87,600	87,600
Fresh Bay	--	--	--	--	--	200,000	200,000
Brackish Marsh Pond and Lake	--	--	--	--	--	55,200	55,200
Brackish Bayou or Canal	--	--	--	--	--	6,200	6,200
Brackish Bay	--	--	--	--	--	58,900	58,900
Saline Marsh Pond or Lake	--	--	--	--	--	64,400	64,400
Saline Bayou or Canal	--	--	--	--	--	6,100	6,100
Saline Bay	--	--	--	--	--	53,800	53,800
Shallow Gulf	--	--	--	--	--	804,000	804,000
TOTAL	81,000	2,000	--	--	70,900	1,548,500	1,535,500

[1/] Includes the area bounded by a line one-quarter mile west of the WABPL north of Verdunville and a line one-quarter mile east of the EABPL north of Bayou Sorrel.
[2/] Includes all lands outside the protection levees south of Verdunville on the west side and the Lower Atchafalaya River backwater complex.

within the Lower Atchafalaya Basin Floodway, and 2,700 acres in the backwater area northeast of Morgan City. This association occurs in conjunction with newly accreted land or recently disturbed areas and propagates in the presence of bare mineral soils and in settings which lack overhead shade and competition from other nearby vegetation (Putnam et al., 1960; Fowells, 1965, and Johnson, 1973). This forest type can be found throughout the basin and intermixed with cypress-tupelo in former swamp areas which no longer experience long hydroperiods. Largest concentrations of early successional bottomland hardwood forests are evident in the Grand and Sixmile Lakes area (Plate A-13). The islands in these lakes provide a nucleus for trapping sediment which is conducive to accelerating the production of land with surface elevations well above the low water elevations during the growing season. These areas are in primary stages of forest succession and are undergoing rapid changes in terms of species composition of the floral community. Eventually, late successional bottomland hardwood forests will develop and occupy the areas. The present community in the Grand and Sixmile Lake area consists of several dominant overstory species with a shade tolerant understory that is constantly being changed by annual floods. This vegetation type does not represent a quality habitat for most species of wildlife, but is heavily utilized by certain seasonally-abundant species such as the yellow-rumped warbler (Kennedy, 1977) or by white-tailed deer when basin water levels are low (Evans, 1976).

A.5.38. Overstory. The three dominant tree species that occur in the early successional bottomland hardwood association are cottonwood, willow and sycamore. These may occur as pure stands or as a mixture. Willows are quite water and sediment tolerant and are vigorous invaders of a newly accreted site (Teskey and Hinckley, 1977). Cottonwoods appear to invade somewhat drier sites than willows and may be succeeded by sycamore, hackberry, and American elm. Other trees often found in this community include boxelder, Drummond red maple, roughleaf dogwood, cypress, and ash.

A.5.39. Understory. Cottonwood, willow, and sycamore are not shade tolerant and their seedlings will not establish under a closed overstory (Fowells, 1965). This factor is responsible for the change of this community to mid-successional bottomland hardwoods. The understory of the early successional community is sparse where the tree crowns are closed, particularly in young, dense stands. Well-developed understory is limited to older stands that have become thinned through age and maturation. The thinner mature stands allow light penetration and support shrubs, vines, herbaceous plants, and grasses. This species association has the lowest diversity of woody understory of all habitats in the basin and the second lowest herbaceous understory diversity. Percent ground cover is midway between that of swamp and late successional bottomland hardwoods (McClanahan, 1975). Typical shrubs are waxmyrtle, leadplant, and button bush. Common vines include Virginia creeper, poison ivy, peppervine, trumpet

creeper, and ladies' eardrops. Common herbs or semiwoody plants are goldenrod, blackberry, false nettle, cockelbur, St. Johnswort, lizard's tail, smartweeds, horsetails, beggar's ticks, and thoroughworts.

A.5.40. Commercial Forestry Potential. During the early stages of development of this community, pulpwood production represents the major forest product, although lack of access limits its harvest in much of the basin. Maturation of the cottonwood and sycamore stands results in the availability of quality saw timber. Even after attaining saw timber diameter, however, willow is still considered a poor-quality product. Cottonwood is used for pulp, matches, boxes, and crates. Willow is used for boxes, crates, and other wooden ware. Sycamore wood is used for veneer, trim paneling, boxes, crates, and concealed parts of furniture.

A.5.41. Mammals. The carrying-capacity of early successional bottomland hardwoods for most species of forest wildlife is inferior to that of mature bottomland hardwoods but higher than that of cypress-tupelo. The white-tailed deer is the most common big game species inhabiting this region while the swamp rabbit is the major small game species. Various small game and furbearing species like the fox, bobcat, opossum, and raccoon also use this habitat. In terms of nongame mammals, this habitat type has a lower species diversity than mature bottomland hardwoods. Some of the more common species present include the eastern mole, the armadillo, and the hispid cotton rat. The lack of mast and browse probably accounts for the low carrying-capacity and species diversity. The early successional community is inferior to both bottomland hardwood and cypress-tupelo communities in furbearer production. It is not preferred as a trapping area, but established populations of raccoon, nutria, opossum, and some beaver do exist there. Additional information concerning the mammals of this habitat type may be found in Nichols (1971), Evans (1976), Heuer (1976), and Hebert (1977).

A.5.42. Birds. A thorough study of the bird populations of the basin was made by Kennedy (1977). Efforts were concentrated on the early successional communities on the banks of the Atchafalaya River main channel and did not include the extensive areas of this association in the lower basin. The results of the study indicated that the early successional community supports the second greatest diversity of major forest types in the Atchafalaya Basin. It is the preferred habitat for about 10 species of warblers, vireos, owls, sparrows, and tanagers and an acceptable habitat for the American woodcock. Nine species, common or abundant in the basin, include the white-throated sparrow, ruby-crowned kinglet, tufted titmouse, red-eyed vireo, and prothonotary warbler. Early successional communities located along the water courses in areas susceptible to annual flooding provide protective habitat and resting sites for migratory waterfowl but do not provide quality food. However, during peak migratory periods (April, August and September) and low-flow years, migrant species

utilize these areas. Because of considerable overflow during normal years, more attractive habitat is available and prompts the use of early successional communities.

A.5.43. Reptiles and Amphibians. The early successional community has the second greatest diversity of these animals of the major habitat types in the study area. Fifty-seven species may be expected to use this forest type (Keiser, 1976). Of the 21 species of salamanders, frogs, and toads present in the basin, 18 may be expected to occur here. Of the 45 species of lizards, snakes, turtles, and the alligator present, 39 may be expected to occur. Thus, this habitat is of major importance for this animal group. Additional detailed data on the herpetofauna of the basin can be obtained from the report by Keiser (1976).

A.5.44. Invertebrates. The early successional bottomland hardwood forest type furnishes habitat for most of the common groups of invertebrates. Protozoans, nematodes, mosquitoes, moths and butterflies, dragonflies, buck flies, bees and wasps, beetles, snails, spiders, ticks, and mites are all common. These animals play a vital role in the food web because many are eaten by other invertebrates, fish, amphibians, reptiles, birds, and mammals. Many of these animals are herbivorous while others are scavengers of dead plant and animal matter. Some are biting pests of man and other animals.

A.5.45. Value as Aquatic Habitat. At the present time, approximately 73,300 acres of early successional bottomland hardwoods in the Lower Atchafalaya Basin Floodway are flooded during an average year. While flooded, these areas function as aquatic habitat and are utilized as spawning, nursery, and forage areas by numerous species of fish and shellfish. The submerged litter and ground cover begin to decay and to be surrounded by a halo of bacteria and fungi (detritus) and becomes a vital part of the aquatic food web.

MID-TO-LATE SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.5.46. General. The mid-to-late successional bottomland hardwood forests of the project area are typical of the hardwoods of the Mississippi River flood plain and are predominantly located in the Red River backwater area, the Morganza and West Atchafalaya Floodways, the backwater area northeast of Morgan City and on the elevated ridges in the Lower Atchafalaya Basin Floodway. These natural ridges have formed along bayous as a result of regular overbank flooding and deposition of silt. Generally, they occur as very narrow banks on small bayous, but are quite extensive along larger bayous and along the Atchafalaya River. These ridges commonly support vegetation similar to the drier bottomland hardwood areas north of Interstate Highway 10 (I-10). However, in the southernmost part of the study area some of

these natural ridges have subsided and eroded to the extent that they will no longer support trees. Bushy thickets of eastern baccharis and waxmyrtle usually take over here. Along many bayou ridges in the Belle River area there are dead or dying live oaks caused by high water levels. There are approximately 870,000 acres within the project area while within the Lower Atchafalaya Basin Floodway there are 247,000 acres, and in the backwater area northeast of Morgan City there are 85,000 acres. *Mixed hardwood associations vary according to species tolerance to soil types and intermittent flooding conditions. However, all species in this forest type are able to tolerate at least infrequent flooding of short duration.* The arrangement of the vegetation, which varies from dense to open stands, produces a diversified habitat with adequate food and cover capable of sustaining high populations of different forms of wildlife. Of the various vegetative communities in the basin, the mid-to-late successional bottomland hardwoods are the most productive in terms of commercial forest products and wildlife.

A.5.47. Overstory. Diversification in terms of species composition of the overstory is greatest in this habitat type. The better drained silty loams in the northern parts of the study area support an oak-dominated overstory with the common species being water oak, willow oak, American elm, and sweetgum. The more poorly drained soils support primarily bitter pecan, overcup oak, Nuttall oak, Drummond red maple, and various ashes. On the high, well drained soils along the Atchafalaya River one finds sycamore, hackberry, willow, cottonwood, and boxelder. Throughout the area covered by this habitat type, scattered cypress may be found.

A.5.48. Understory. The understory of this association is comprised typically of seedlings of the overstory species and a variety of shrubs, vines, and herbaceous cover. This habitat type has the most diverse woody understory of all habitat types in the basin. The more common shrubs on better drained sites include snowbell, deciduous holly, waxmyrtle, palmetto, and various hawthorns. On poorly drained sites, water elm and swamp privet occur and on certain sites within the Henderson Lake area where water is artificially impounded, these species may form an almost impenetrable thicket that prevents the growth of a ground cover due to the dense shade. The dominant vines include poison ivy, Virginia creeper, peppervine, rattan vine, and various greenbriars. Herbaceous cover is the most diverse in any habitat type in the basin with butterweed, lizard's tail, shield fern, oak forest grass, false nettle, yankeeweed, asters, elephant's foot, and smartweeds being among the most common species.

A.5.49. Commercial Forestry Potential. Several areas in the basin are logged for timber products such as hardwood lumber, veneer logs, pilings, poles, commercial posts, and pulp. The bulk of the volume harvested from mature bottomland hardwoods is provided by oaks and ashes. However, a number of other species are taken, including

American elm, bitter pecan, boxelder, Drummond red maple, cottonwood, hackberry, sweetgum, and sycamore.

A.5.50. Mammals. The white-tailed deer is the major big game species within the mid-to-late successional bottomland hardwood community (carrying-capacity for game species is discussed subsequently in this section). Black bears are found in certain portions of this area but not in sufficient numbers to be considered a major big game species. Rabbits and squirrels are the most common small game species within the area (Heuer, 1976). Mid-to-late successional bottomland hardwood forests contain the greatest species diversity and numbers of nongame mammals because of the amount of food and cover available (Heuer, 1976). Furbearers, such as coyotes and hybrid dog-coyotes, have also become fairly common in recent years. Some of the more common species include various bats, the armadillo, marsh rice rat, hispid cotton rat, and eastern wood rat. These forests support the greatest density of small mammals of any habitat type in the basin (Hebert, 1977). Although none of these animals are of sport or commercial importance, they are a vital part of the food web. The various rats and mice are especially important because of their abundance. These areas have good potential for fur production but are not heavily trapped. A study conducted by Nichols (1973) indicated that these areas support a higher population of mink and raccoon than the remainder of the basin. Additional information on the mammals of this habitat type may be found in the references previously cited in the section on early successional bottomland hardwood forests.

A.5.51. Birds. Mid-to-late successional stage bottomland hardwood forests have the greatest bird species diversity in the Atchafalaya Basin, as well as the highest numbers of individuals per unit area (Kennedy, 1977). In all months except April, August, and September, more species utilize these bottomlands than any other habitat type. These forests are the preferred habitat for approximately 40 species of woodpeckers, flycatchers, thrushes, wrens, and warblers. Fifteen species are common to abundant, including the red-bellied woodpecker, Acadian flycatcher, cardinal, Carolina wren, Carolina chickadee, and parula warbler. The presence of mast-producing trees coupled with the overflow regimen makes this region potentially a very valuable waterfowl wintering area. Although this area may winter as many as 20 different species of waterfowl, the mallard and the wood duck are most common. In addition to its importance as a wintering area, this region is an extremely important production area for breeding populations of wood ducks, probably due to the availability of nesting cavities and brood-rearing habitat. This region of the basin winters one of the largest concentrations of woodcock in North America (Glasgow and Noble, 1974, and Evans, 1976). The hardwood forests are used primarily for cover and feeding during the day while at dusk, large concentrations of these birds move from the forested areas to open fields. Since its reintroduction into the basin in the mid-1960s, the wild turkey has expanded its range to include the area

north of I-10, as well as areas south of I-10 near Butte LaRose. The previously cited study by Kennedy (1977) provides additional information on the bird populations of this habitat type.

A.5.52. Reptiles and Amphibians. Keiser (1976), in his study of the herpetofauna of the basin, reported that 61 species occur in the mid-to-late successional bottomland hardwood forest type. This includes 20 out of a basin-wide total of 21 species of salamanders, frogs, and toads, and 41 out of a basin-wide total of 45 species of lizards, snakes, turtles, and the alligator. Only nonagricultural open land habitats, such as levees, contained an equal number of species. Due to its large areal extent within the basin, the mid-to-late successional bottomland hardwood forest type is, therefore, of major importance as habitat for this animal group, particularly where it is not subjected to excessively long hydroperiods, but where it does contain some permanent water bodies.

A.5.53. Invertebrates. Mid-to-late successional bottomland hardwood forests have an abundance of invertebrates of all types due to the presence of a well-developed ground cover, understory, and overstory vegetative layers in many areas within this habitat type. Interspersion of the vegetative community with the many water bodies of the basin further enhances the opportunities for invertebrate species to live.

A.5.54. Value as Aquatic Habitat. Mid-to-late successional bottomland hardwoods are valuable to fishery resources because they provide detritus as well as feeding, spawning, and nursery habitat when flooded. Approximately 128,000 acres in the Lower Atchafalaya Basin are flooded during an average year.

CYPRESS-TUPELO SWAMPS

A.5.55. General. The most extensive swamps are located on the southeast side of the basin between Flat Lake and the east Atchafalaya Basin access channel as well as east of the lower floodway between Lake Verret and Houma (Plates A-12 and A-13). The cypress-tupelo region is very flat and much of it remains inundated for about 6 or more months of the year. Water from a few inches to several feet in depth normally covers the area from late fall or early winter (November-January) until early summer (May-June). The vegetative associations vary from a mixed stand of various water tolerant species to a monotype of cypress or tupelo. In drier areas, bottomland hardwood species may occur intermixed with the cypress and tupelo. South of Morgan City, a maple-willow zone occurs at the transition between swamp and marsh. Pockets of maple-willow or cypress-tupelo also occur within the marsh. These habitats are favorable for wildlife populations that are aquatic-oriented at some stage in their

lives. The cypress-tupelo swamps are generally considered to be less productive for wildlife than the mid-to-late successional bottomland hardwood forests, but more productive than the early successional community (see subsequent discussion in this section for habitat unit values). Approximately 481,000 acres of this habitat type occur in the project area; 176,000 of these acres are in the Lower Atchafalaya Basin Floodway and 275,000 acres are in the backwater area northeast of Morgan City. Because they are flooded for a portion of each year, these swamps are also a part of the aquatic ecosystem. Since swamps were studied by the Louisiana State University Cooperative Fishery Research Unit (Bryan, et al., 1974, 1975, and 1976) during their aquatic characterization of the floodway, the role of swamps in the aquatic system is discussed in a subsequent section.

A.5.56. Overstory. In comparison to the bottomland hardwoods, species diversity is greatly reduced in the swamps due to the greater frequency and duration of flooding. Cypress and tupelo dominate the swamp vegetation with pumpkin ash, green ash, Drummond red maple, and black willow also present (Hoffman, 1973; Fowells, 1965; US Department of the Interior, 1974; and O'Neil et al. 1975). Black willows invade cypress-tupelo areas where the canopy is open and sedimentation has reduced depth and duration of standing water. As water levels drop, other bottomland hardwood species also invade. Deeply flooded swamps that never dry will eventually convert to open water while swamps that dry occasionally may convert to a shrub swamp dominated by buttonbush, water elm, and swamp privet. In the transition zone south of Morgan City, the overstory consists of a mixture of Drummond red maple and black willow.

A.5.57. Understory. Both cypress and tupelo are fairly intolerant of shade and require considerable light for seedling development, as well as exacting water condition. Accordingly, seedlings of these two dominant overstory species occur sparingly in the understory. Woody understory in the swamp is much more sparse than in bottomland hardwoods but ground cover or herbaceous species such as water hyacinth, smartweeds, alligatorweed, arrowheads, lizards's tail, duckweed, and spiderlily do occur. Water hyacinth may completely cover the swamp floor in many locations. Common woody understory shrubs include buttonbush, water elm, and swamp privet. Vines are not abundant in this habitat type. In the maple-willow swamps south of Morgan City, various fresh marsh species occur as understory.

A.5.58. Commercial Forestry Potential. A large portion of the cypress-tupelo acreage supports a potential for present and future timber production. Since most of the cypress are 50-70 years old, they are approaching marketable age. Cypress represents, by far, the majority of the volume of timber harvested from the swamp. Both cypress and tupelo are lumbered for veneer logs, furniture, and other timber products. Cypress is used for making handmade shakes, fence-posts, construction timbers, siding, greenhouse and hotbed lumber,

interior trim, fancy paneling, window frames, doors, furniture, and fine cabinet construction (Brown, 1945). Since tupelo is a softwood, it is used primarily for interior trim.

A.5.59. Mammals. The absence of hard mast producing trees and the rather sparse understory (except for water hyacinth), caused by the depth and duration of inundation, greatly limit the carrying-capacity of this community for game species. Carrying capacities of this region are generally lower than in mid-to-late successional bottomland hardwood forests. Squirrels are present in population densities directly proportional to the quality of the overstory. Swamps have a lower species diversity than bottomland hardwoods. Some of the more common nongame mammals include various bats and the southern flying squirrel. These animals, although not of sport or commercial value, play a vital role at many levels of the food web. The cypress-tupelo community is heavily utilized by beaver, nutria, mink, and raccoon. This region is the most frequently trapped area of the basin. A study conducted by Nichols (1973) indicated that success for nutria was highest in this area. Additional information on the mammals of this habitat type may be found in the references cited in the section on early successional bottomland hardwood forests.

A.5.60. Birds. The cypress-tupelo swamps serve as extremely important breeding and production areas for wood ducks. Areas within the cypress-tupelo community that do not contain standing water but which possess moist soils provide feeding areas that are utilized by woodcock. Dense stands of shrubby understory vegetation, sometimes associated with this community, provide daytime resting areas for woodcock throughout the fall and winter. Cypress-tupelo swamps that maintain permanent standing water provide an attractive habitat to wintering waterfowl. The better areas within this community, however, are those that regularly dry up and allow seed producing annuals to invade. The quality of such areas is generally comparable to that of regularly inundated bottomland hardwoods. Cypress-tupelo swamps have the lowest bird species diversity of the major forest types in the Atchafalaya Basin. Within this community, the greatest diversity and numbers usually occur in the winter. These swamps are the preferred habitat for approximately 15 species of herons, egrets, ibises, vireos, flycatchers, warblers, and the anhinga. Only four species (the barred owl, the Carolina chickadee, and the prothonotary and parula warblers) are common to abundant in swamps. Several rookeries have been located in the Atchafalaya Basin. All occur in stands of mixed-age cypress with swamp privet and buttonbush in the understory. The species using these rookeries include anhingas, herons, egrets, and ibises. Kennedy (1977) provides additional information regarding the bird populations of this habitat type.

A.5.61. Reptiles and Amphibians. Cypress-tupelo swamps exhibit a lower species diversity of reptiles and amphibians than the bottomland hardwood communities. Keiser (1976) reported 51 species in this

habitat type. He found 18 species of salamanders and frogs out of a total of 21 amphibian species present in the basin and 33 species of lizards, snakes, turtles, and the alligator out of a total of 45 reptiles present in the basin as a whole.

A.5.62. Invertebrates. Baldcypress-tupelogum swamps furnish habitat for a large number of invertebrate species, especially those spending all or a part of their life cycle in the water. These swamps are particularly important for the production of red swamp crawfish.

MARSHES

A.5.63. General. The lower reaches of the Atchafalaya Basin consist of a complex of marshes bordering the Gulf of Mexico. Salinity and elevation are the major factors influencing the types of vegetation here. The marshes can be generally classified as fresh, brackish, or saline. For the purposes of this study, Chabreck's intermediate marsh (Chabreck, 1972) has been classed as fresh. These areas are capable of producing, harboring, and nourishing an exceptional array of vertebrate and invertebrate fauna.

A.5.64. An important factor that influences the productivity of these marshes is their proximity to the Lower Atchafalaya River and the Wax Lake Outlet. The marshes that are overflowed regularly by these two outlets to the basin receive a steady supply of sediment and nutrients, and are thus highly productive. The marshes that receive river water regularly have the lowest land loss rate coastwide.

A.5.65. Marsh Acreage. In 1968, Chabreck mapped and measured the marshes of Louisiana by salinity and hydrologic unit (Chabreck, 1972). He repeated the study in 1978 but only published a map. Since the same base map was used for both studies, one can calculate the change in habitat types from 1968 to 1978 by comparing the maps, but it is impossible to determine actual loss of marsh. Adams et al. (1978) studied long term marsh losses over an 11- to 23-year period. They studied loss at several specific sites in the project area. Adams and Bauman have ongoing studies that compare pre- and post-flood marsh conditions within the project area. Wicker (1980) has just completed a study for the USFWS that delineates marsh loss from 1955 to 1978 by US Geodetic Survey quadrangle maps. These three studies investigated different size areas and utilized different methods and, understandably, each study came up with varying loss rates for the same general area. These loss rates will be discussed further as each vegetative type is described. To calculate 1980 marsh acreage, the differences by habitat types and hydrologic unit were calculated from Chabreck's 1968 and 1978 maps. The appropriate loss rates were applied to the 1978 acreage.

TABLE A-5-8

FUR CATCH BY MARSH TYPE

	AVERAGE CATCH PER ACRE [1/]		
	Fresh[2/]	Brackish	Saline
Muskrat	0.900	0.084	0.017[3/]
Nutria	0.400	0.900	Insignificant
Mink	0.002	0.001	Insignificant
Otter	Insignificant	Insignificant	Insignificant
Raccoon	0.009[4/]	0.008	Insignificant

1/ From Palmisano (1973).
2/ Represents mean of fresh and intermediate marsh average harvest/acre.
3/ Calculated as 25% of brackish marsh harvest/acre.
4/ Represents one-half of combined maximum production for fresh and intermediate marsh.

ibises, are present. Sea birds, such as common terns, ring-billed gulls, and laughing gulls, use the fresh marshes and shore birds, such as black-necked stilts and killdeer, are common. Birds of prey, such as marsh hawks and red-shouldered hawks, hunt in the marsh. Red-winged blackbirds, common grackles, and seaside sparrows are also common.

A.5.71. Reptiles and Amphibians. Keiser (1976) reports a total of 10 frogs, 3 salamanders, 2 lizards, 14 snakes, 8 turtles, and the alligator as being expected to occur in the fresh marshes of the study area. The American alligator is common and present in huntable populations. The potential annual harvest is nearly 10 per 1,000 acres (Table A-5-9).

A.5.72. Fishes. The regularly flooded fresh marshes provide habitat for numerous small fish, such as mosquitofish, silversides, sailfin mollies, least killifish, and sheepshead minnows. Larger fish, such as sunfish, gar, and menhaden, live in the deeper waters of the bayous and occasionally venture into the flooded marsh when the water is deep

FRESH MARSHES

A.5.66. General. Fresh marshes are the most common type in the project area due to the influence of the freshwater of the Atchafalaya River. As indicated on Plates A-13 and A-14, these fresh marshes lie immediately south of the Bayou Teche and Bayou Black ridges. They extend southward to the shore of Atchafalaya Bay and approximately to the north end of Four League Bay. In 1980, there were approximately 323,000 acres in the project area. Between 1968 and 1978, marshes in parts of this area showed a gain in acreage while elsewhere the acreage remained the same. In areas gaining acreage, brackish marsh converted to fresh marsh. Water levels do not fluctuate greatly in fresh marsh and the decaying plant material accumulates as peat. Some of the fresh marshes in the area away from the river consist of a floating peat layer supporting a stand of marsh vegetation.

A.5.67. Loss Rates. Fresh marshes adjacent to the Lower Atchafalaya River and Wax Lake Outlet generally show a gain in marsh acreage. Wicker et al. (1980) shows a loss rate from 0.14 to 0.25 percent per year while Adams and Bauman (1980) and Adams et al. (1978) indicate a gain. The riverborne sediments prevent erosion and build new marsh. These marshes have a firm foundation and are interlaced with a network of small bayous. On the other hand, fresh marshes in Terrebonne Parish away from the riverflow show evidence of marsh loss, with loss rates increasing with distance from the Atchafalaya River. The loss rate indicated by Wicker et al. (1980) varies from 0.73 to 0.97 percent per year.

A.5.68. Vegetation and Salinity. Fresh marshes have the greatest vegetation species diversity of any marsh type. The most abundant plant is maidencane. Bulltongue, spikerush, pennywort, deer pea, and cattail are all common. Salinities in fresh marshes range from 0.06 to 6.7 ppt with a mean of 1.5 ppt.

A.5.69. Mammals. Fresh marshes provide prime habitat for the nutria. The mean harvest per 1,000 acres is 400 (Palmisano, 1973). Other furbearers, such as muskrat, mink, raccoon, and otter, are also present in trappable numbers (Table A-5-8). White-tailed deer are present with an average carrying-capacity of one deer per 300 acres. Fresh marshes provide habitat for large numbers of swamp rabbits. Various other species, such as opossums, marsh rice rats, and hispid cotton rats, also utilize fresh marshes.

A.5.70. Birds. The abundant food and shallow waters of the fresh marshes attract large numbers of wintering waterfowl, especially puddle ducks. Mallards, green-winged teal, blue-winged teal, pintails, American wigeons, gadwalls, and shovelers are common during the winter, as are snow geese and king rails. The mottled duck is a resident in fresh marshes. Wading birds, such as great blue herons, Louisiana herons, great and snowy egrets, and white-faced and white

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TABLE A-5-9

POTENTIAL ALLIGATOR HARVEST BY MARSH TYPE[1/]

Marsh Type	Hides Per Acre
Fresh	0.010
Brackish	0.006
Saline	Insignificant

[1/]From Joanen (personal communication), Louisiana Department of Wildlife and Fisheries.

enough. Additional information concerning marsh fish can be found in Bryan et al. (1976) and Stone (1980).

A.5.73. Invertebrates. Insects play a vital role in fresh marshes. Most are grazers but others, such as dragonflies, are carnivorous. Fire ants are common. Since the marsh is regularly flooded, many aquatic invertebrates, such as worms, snails, nematodes, and copepods, exist either on flooded marsh grasses or in saturated marsh soil. Marsh invertebrates are discussed in more detail by Gosselink et al. (1979).

A.5.74. Commercial and Sport Value of Fresh Marsh. The fresh marsh provides numerous user-days of hunting in the project area. Based on data in US Fish and Wildlife Service (1980), a sport hunting potential of 0.826 user-days per acre exists (Table A-5-10). The number of furs harvested per acre is shown in Table A-5-8. Fresh marshes have an alligator harvest potential of 0.010 per acre (Joanen, personal communication).

BRACKISH MARSHES

A.5.75. General. Brackish marshes form a band gulfward of the fresh marshes in Terrebonne Parish. As can be seen from Plate A-14, the band is narrow near Atchafalaya Bay and widens as the river influence wanes. In 1980, there were approximately 89,000 acres of brackish marsh in the project area (Table A-5-6). Between 1968 and 1978, the total acreage of brackish marsh in the area decreased. In 1968, the area west of Wax Lake Outlet had 11,000 acres of brackish marsh; but by 1978, this had converted to fresh marsh due to the river influence.

A.5.76. Loss Rates. All studies indicate a progressively increasing loss rate in brackish marsh going eastward, away from the influence of

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TABLE A-5-10

SPORT HUNTING POTENTIAL AND VALUE
BY MARSH TYPE

Marsh Type	Hunting Type		Potential Effort/ Acre (User-days)
Fresh/intermediate[1/]			
	Deer		0.017 [2/]
	Rabbit		0.104 [2/]
	Raccoon		0.005 [2/]
	Waterfowl		0.480 [3/]
	Rail and Snipe		0.220 [4/]
		TOTAL	0.826
Brackish			
	Deer		Insignificant
	Rabbit		0.069 [2/]
	Raccoon		0.004 [2/]
	Waterfowl		0.380 [5/]
	Rail and Snipe		0.190 [4/]
		TOTAL	0.643
Saline			
	Deer		Insignificant
	Rabbit		0.021 [2/]
	Raccoon		0.003 [2/]
	Waterfowl		0.020 [4/]
	Rail and Snipe		0.250 [4/]
		TOTAL	0.294

1/ Assuming 1/3 area intermediate, 2/3 fresh marsh.
2/ From data furnished by USFWS.
3/ Based partially on records for public waterfowl hunting on Lacassine National Wildlife Refuge, 1978-79 hunting season.
4/ Based on US Army Corps of Engineers (1974).
5/ Based on records for public waterfowl hunting on Sabine National Wildlife Refuge, 1978-79 hunting season.

the nutrients and sediments of the Atchafalaya River. The rate near Four League Bay is 0.42 percent per year while near Lake Mechant the rate is 1.51 percent per year.

A.5.77. Vegetation and Salinity. Brackish marshes are intermediate in vegetative diversity between fresh and saline. The most abundant plant present is wiregrass while three-cornered grass, saltgrass, deer pea, and soft rush are common. Salinities can range from extremes of zero to 28 ppt with a mean salinity of 8 ppt and a general range of 6 to 18 ppt.

A.5.78. Mammals. Muskrats prefer brackish marshes. The average catch is 84 per 1,000 acres (Palmisano, 1973). Other furbearers, such as nutria, mink, otter, and raccoon, can also be found. Swamp rabbits, marsh rice rats, and opossums are present. (Gosselink et al., 1979).

A.5.79. Birds. Both puddle ducks and diving ducks are attracted to brackish marshes in moderate numbers. Wading birds are numerous at all times but become exceptionally abundant during spring and summer. Sea birds, such as ring-billed gulls, laughing gulls, and Forster's terns, are common. Shore birds, such as plovers and sandpipers, are also present. Additionally, swallows, red-winged blackbirds, wrens, and savannah sparrows are common inhabitants of the brackish marsh (Gosselink et. al., 1979).

A.5.80. Reptiles and Amphibians. Brackish marshes do not generally provide habitat for large numbers of amphibians; however, five species of frogs and toads have been reported. Reptiles are more common, with five species of turtles and 10 species of snakes present (Gosselink et al., 1979).

A.5.81. Fishes. Brackish marshes provide valuable nursery habitat for several species of fish and shellfish, especially menhaden and white shrimp. The decaying brackish marsh grass plays a vital role in the food web.

A.5.82. Invertebrates. Nematodes and polychaete worms are abundant, although benthic species richness is low in brackish marshes. Ostracods and amphipods are also common. Water beetles, biting midges, and dragonflies are common predaceous insects (Gosselink et al., 1979).

A.5.83. Commercial and Sport Value of Brackish Marsh. Sport hunting is less in brackish than in fresh marsh. Potential user-days per acre are shown in Table A-5-10. From Table A-5-8, it can be seen that fur catch is lower in brackish than fresh marshes. Potential alligator harvest in brackish marsh is 0.006 per acre (Joanen, personal communication). The detritus produced by the brackish marsh plants is part of a food web that supports most sport and commercial fish and shellfish.

SALINE MARSHES

A.5.84. General. Saline marsh is present only in the southern part of Terrebonne Parish where there are 108,000 acres. The fringe of saline marsh is very narrow near Atchafalaya Bay and widens to several miles farther east. Between 1968 and 1978, the actual amount of saline marsh in Terrebonne Parish decreased by 11,600 acres. Most of these acres have become brackish marsh.

A.5.85. Loss Rates. Wicker et al. (1980) indicates a much larger loss rate adjacent to Terrebonne Bay (1.26 percent per year) than in saline marsh near Four League Bay (0.47 percent per year).

A.5.86. Vegetation and Salinities. Plant species diversity is low in saline marshes. Oystergrass is the dominant species with saltgrass, wiregrass, and black rush also present. Salinities can range from 1 to 35 ppt with a mean of 18.

A.5.87. Mammals. There are few mammals present in saline marshes. Some muskrats live there as well as the raccoon, opossum, swamp rabbit, and marsh rice rat.

A.5.88. Birds. Wading birds utilize saline marshes in large numbers. More gulls and terns are present in these marshes than in other types. Other shore birds are also common because the tidal fluctuation produces extensive mudflats for feeding. In general, more shore bird species utilize saline marshes than any other marsh type.

A.5.89. Reptiles and Amphibians. Saline marshes provide very poor habitat for these animals. Generally, no amphibians are present and the only two species of reptiles likely to be encountered are the salt marsh water snake and the diamondback terrapin.

A.5.90. Fishes. These marshes provide valuable nursery and feeding habitat for numerous estuarine dependent fish and shellfish. During regular tidal inundation, vast acreage of salt marsh becomes available for young fish, shellfish, and their predators. Spotted seatrout, red drum, shrimp, and blue crabs all rely on these marshes for nursery areas. The detritus produced from decaying marsh grasses is a vital part of the food web.

A.5.91. Invertebrates. Leafhoppers, grasshoppers, flies, and mosquitoes are some of the terrestrial insects present. Spiders are important carnivores in saline marshes. The marsh periwinkle is a common detritivore. Copepods, amphipods, polychaete worms, and nematodes are present in the sediment. Large numbers of fiddler crabs burrow in the edges of the salt marsh.

A.5.92. Commercial and Sport Value of Saline Marsh. Due to the lack of mammals, only muskrats are trapped and those in very small

numbers. The alligator harvest is negligible. Hunting potential is far less than in other marshes. Only rail and snipe hunting provide a significant number of user-days per acre.

OPEN LAND

A.5.93. General. This land-use category includes: levees, dredged material disposal areas, croplands, and pastures. A total of 528,200 acres of such land is present in the project area; 16,400 acres in the Lower Atchafalaya Basin Floodway; 80,800 acres, in the backwater area northeast of Morgan City; and the remainder, in the area north of the latitude of Krotz Springs.

LEVEES

A.5.94. Flora. Several thousand acres of manmade levees now exist in the project area. These levees are generally maintained free of woody vegetation by frequent mowing. They are vegetated primarily with herbaceous species, including Vasey, smut, Dallis, Johnson, Bermuda, panic grasses and Santa Maria, cyperus, and common ragweed.

A.5.95. Fauna. The regularly maintained levees probably do not provide exclusive habitat for any wildlife species, but do often provide grazing range for domestic cattle and feeding areas for cattle egrets. These areas provide support habitat for white-tailed deer, rabbits, and a variety of nongame species and also provide nesting habitat for large numbers of turtles. During floodflows, these elevated areas serve as a refuge for animals forced out of their habitat by rising waters.

DREDGED MATERIAL DISPOSAL AREAS

A.5.96. Flora. Several thousand acres of terrestrial disposal sites now exist in the project area. The age of the site, degree of flooding, and proximity to other vegetative types generally dictate species coverage and composition. Recently used sites may follow a trend of succession from annual herbs to perennial and biannual herbs to shrubs, or may vegetate immediately with willows. Older sites in nonmarsh areas are often vegetated with trees characteristic of a dry bottomland hardwood type. In the marshes, banks of dredged material occur along canals and navigation channels. Depending on the age of the site, vegetative associations range from primary stages of succession to communities composed of vegetation common to the chenieres of the coastal plains. Generally, an overstory canopy

exists only when disposal sites occur near freshwater marshes. In a saline environment, succession terminates at the shrub stage. Those sites capable of supporting trees will succeed to black and sandbar willows and Chinese tallow trees following the shrub stage and later to hackberry and live oak. In general, the understory will vary with the proximity of the site to fresh or saline waters. In freshwater areas, black and sandbar willow, yankeeweed, aster, and goldenrod are early colonists. Later, eastern baccharis, elderberry, and deciduous holly become established. Understory species on disposal banks near saline waters include marsh elder, eastern baccharis, sea-purslane, hogcane, feather fingergrass, wiregrass, and saltgrass.

A.5.97. Fauna. Basically, species inhabiting disposal areas would be characteristic of the species occurring in a vegetative community similar to that of the disposal site. Therefore, during the early stages of succession, wildlife species would be representative of those common to the early successional association, and as succession progressed, the species composition would change gradually to one typical of a bottomland hardwood forest. Shrub areas in the marshes support swamp rabbits, raccoons, and various species of snakes, rats, and mice. Embankments of dredged material, throughout the project area, serve as a refuge for animals during high water. The embankments of shrubs and trees in the marsh provide valuable resting and feed habitat for migrating song birds. Animal population densities are generally related to the size of the disposal areas, and some species might not occur unless sufficient supportive habitat contiguous to this area exists.

CLEARED LANDS

A.5.98. Flora. Several hundred thousand acres of the project area have been cleared for agricultural purposes, including both row crops and pasturelands. Row crops of the area include soybeans, corn, milo, cotton, rice, and sugarcane. Pasturelands are vegetated with Dallis grass, bahia grass, Bermuda grass, bluegrass, winter grass, and winter grains, such as wheat. Various other herbaceous species, including Johnson grass and smutgrass, occur along fence rows, field borders, and ditch banks.

A.5.99. Fauna. Numerous small mammals and birds depend on agricultural areas for food and cover, especially the cottontail rabbit, bobwhite, woodcock, mourning dove, and various songbirds. Big game animals like the white-tailed deer and the wild turkey use these agricultural areas, especially soybean fields and improved pastures, as a supplemental food source or as brood-rearing habitat.

A.5.100. This is a unique area that includes a vegetative mixture of early successional bottomland hardwood forests, disposal areas, and marshes. The 10,100-acre emerging delta is one of the major deltas on the gulf coast and one of the few in the United States. A heavily utilized navigation channel, running from Morgan City to the Gulf of Mexico, passes through the delta. Due to construction and maintenance of this channel, a line of islands, parallel to the channel, has been built through the bay and to the west. The northern island is about 2.5 miles long, 1 mile wide, and has a crest elevation of 10 feet NGVD. Southward, the islands are smaller and lower. Portions of the islands above 2 feet NGVD are generally covered with black or sandbar willows and various grasses and herbs. Land below 2 feet NGVD is usually vegetated with fresh marsh species, such as delta duck potato, bulltongue, and Walter's millet. West of these disposal areas, natural marshes occur. Disposal of dredged material from maintenance dredging in Atchafalaya Bay is confined to the west side of the channel. All major distributaries are left open so that natural marsh accretion is allowed. In the maintenance program, attempts are made to preserve marsh. The disposal pipe is placed just west of the ridge on the higher islands and much of the dredged material is deposited on the western slope. However, some marsh is lost with each maintenance dredging. In the southern portion of the bay, small disposal islands are built with their centers no more than 3,000 feet apart and their maximum elevation limited to 2.25 feet NGVD. The delta in the eastern portion of the bay is relatively undisturbed by man. Some shell dredging and oil field pipeline construction have occurred. This area is characterized by V-shaped islands with willows forming the "V" and fresh marsh species lying between the arms. In December 1975, an uncontrolled aerial photo mosaic of the area, indicated approximately 1,300 acres of vegetated marsh and 7,000 acres of mudflats. Most of the emergent land was created during the 1973-75 high water period. Since then, very little aerial delta has appeared. Apparently, subsidence and erosion are occurring at a rate that keeps pace with land emergence. Delta growth is linked to greater than normal Atchafalaya River floodflows. This delta, besides being valuable habitat for fish and wildlife, is a natural laboratory in which several groups of scientists are studying the geologic and biologic processes that occur during delta formation. The entire area is owned by the state and is operated as a wildlife management area by the Department of Wildlife and Fisheries. The marshes, mudflats, and shallow bay make it a superb duck hunting area.

CARRYING CAPACITY, HABITAT EVALUATION SYSTEM (HES), AND HABITAT EVALUATION PROCEDURES (HEP)

A.5.101. There are several methods of comparing the value of various habitat types for fish and wildlife. The most simple is carrying-

capacity, which is a measure of the number of animals of various species that can be sustained by an acre of habitat. The USFWS is developing a more complex system called the HEP. These procedures attempt to evaluate habitat in terms of its inherent value to a group of species (usually 10), which characteristically inhabit a given type of habitat. In the evaluation procedure, done for this project in 1977, the value of the habitat for individual species was rated at randomly chosen sites, utilizing habitat parameters thought to be of value as indicators of the quality of the habitat for the species in question. These values for each species, for each site, were then compiled and used to calculate a Habitat Unit Value, which was taken to be a measure of the quality of the habitat for fish and wildlife. In the HES, developed by the US Army Corps of Engineers, Lower Mississippi Valley Division, randomly chosen sites within a habitat type are evaluated and various physical, chemical, or biotic parameters believed to be correlated with the carrying-capacity of the habitat for all fish and wildlife are measured. These measurements are then used to calculate a Habitat Unit Value that is believed to be indicative of the quality of the habitat. Table A-5-11 summarizes the results of studies designed to determine the value of the various habitat types within the project area as expressed by the HES and the HEP.

VEGETATIVE TRENDS

A.5.102. Available aerial photography covering four test strips through the Atchafalaya River Basin in 1930, 1952, and 1973 was used to conduct a vegetation trend analysis (US Department of Interior, 1975). The following discussion presents the findings of the analysis. Within the entire basin from 1930 to 1973, sedimentation has been responsible for substantial decreases in surface water, decreases in the acreage of cypress-tupelo forest, and increases in the acreage of mixed hardwood forest. The portion of the two floodways north of Highway 190 is nearing an oak type climax forest, with vegetative succession more or less stabilized. Clearing of the vast mixed hardwood forests for agriculture is now the evident pattern of land use in this region of the basin. The portion of the basin just north of I-10 shows a large increase in hardwood forests since 1930, and willows are gradually invading the swamps. At a latitude 20 miles north of Morgan City, changes have occurred at an increasing rate. Sedimentation is causing the rapid invasion of cypress-tupelo swamps by willows. At a latitude of 5 miles north of Morgan City, willows are not invading swamps but are pioneering the newly created sandbars in Grand and Sixmile Lakes.

A.5.103. US Army Corps of Engineers studies indicate that the southeastern portion of the basin is a comparatively stable area. The extensive cypress-tupelo swamps on the eastern side of the main channel remain much as they were in 1930.

TABLE A-5-11

EXISTING HABITAT UNIT VALUES

Habitat Type	HES Aquatic	HES Terrestrial	HEP Aquatic	HEP Terrestrial
Mid-to-Late-successional bottomland hardwood forest	27.0	57.5	58.0	64.3
Cypress-tupelo swamp	55.0	67.0	68.0	38.9
Early successional bottomland hardwood forest	27.0	43.2	Not evaluated	34.9
Cropland/pasture/levee		25.6	45.0	16.0
Open gulf			85.0	Not evaluated
Saline pond or lake			83.5	32.6
Saline bayou			82.5	Not evaluated
Saline bay			90.5	27.5
Saline marsh			81.7	34.8
Brackish bayou			63.5	Not evaluated
Brackish bay			73.0	33.4
Brackish marsh			66.1	55.4
Brackish lake			60.5	39.1
Fresh marsh bayou			75.5	Not evaluated
Fresh marsh lake			72.7	54.6
Fresh marsh			81.7	34.8
Active delta			84.5	57.7
Riverine or			52.2[1] 49.5[2] 53.8[3] 46.0[4]	20.8
Fresh bayou	80.0		70.4[1] 52.0[2] 59.0[3] 29.0[4]	56.1
Headwater lake	93.5		68.3	48.0
Backwater lake	90.0		60.0[1] 53.0[2] 58.4[3] 53.7[4]	56.1
Cropland lake	76.0		47.5[1] 47.5[2] 45.5[3] 45.5[4]	34.8

[1] Lower Basin.
[2] Upper Basin.
[3] Lower Red River Backwater.
[4] Upper Red River Backwater.

WEST ATCHAFALAYA AND MORGANZA FLOODWAYS

A.5.104. The separate management of these two floodways has had differing effects on the vegetative trends; however, the general pattern has been one of increased agricultural development rather than a natural succession of vegetation. The predominant forest type since 1930 has been bottomland hardwoods; this community has represented a stable, self-perpetuating natural vegetative type in this area. Between 1930 and 1973, most of the swamp had succeeded to bottomland hardwoods. Generally, the trend in the few remaining swamp areas is a gradual succession toward a bottomland hardwood forest. The predominant trend in these floodways is clearing of bottomland hardwoods for agricultural purposes.

LOWER ATCHAFALAYA BASIN FLOODWAY

A.5.105. Along the latitude of Henderson and Ramah (below I-10), sedimentation has played a significant role in vegetative succession patterns. The overall trend has been a large decrease in the extent of the mature, sparse cypress-tupelo swamps and an increase in the acreage of willows, bottomland hardwood forests, and human development. In 1930, this area was dominated almost equally by cypress and willow. Sparse cypress-tupelo acreage had decreased by more than 80 percent. Finally, in 1973 the trend of vegetative succession had placed bottomland hardwoods and cypress mixed with willow as the dominant forest types in this region.

A.5.106. Along the latitude of New Iberia and Pierre Part (about 20 miles north of Morgan City), sedimentation has also played a significant role in vegetative succession patterns. Of prime significance in this area is the increasing rate at which changes are occurring. In 1930, almost half of the area was cypress-tupelo forests. By 1952, this forest type had decreased only slightly. The change from 1952 to 1973, however, was dramatic; the vast cypress-tupelo forests that were present between 1930 and 1952 had been completely transformed into a cypress-willow-tupelo type. Some of the areas that experienced this succession include the area to the east of Little Bayou Pigeon, Hog Island, the area between Grand Lake and Little Bayou Pigeon, and Turkey Island.

A.5.107. Along the latitude of Franklin (about 5 miles north of Morgan City), marked contrast exists in the patterns of vegetative succession. The forest cover type of this area in 1930 was predominantly the cypress-tupelo association, although intensive logging activities prior to that time had substantially decreased the number of mature cypress in the area. There were no stands of willow in this area in 1930. In 1952, the forest cover types were much the same as in 1930. Despite the seeming stability in forest cover types,

however, a significant change had occurred. Newly accreted lands had emerged in the vicinity of Grand and Sixmile Lakes and these became the sites of extensive pure stands of young willow trees. The 1973 forest associations were essentially the same as in 1952. The dominant cover type remained cypress-tupelo. The trend of emergence of new stands of willows in the Grand Lake and Sixmile Lake region, first evident in 1952, continued at an increasing rate through 1973. As large areas of newly accreted land appeared, extensive stands of pure willows became established and dominated the vegetative type of the western half of this area. This newly accreted land has considerably decreased the surface area of water in the lower part of the basin.

Aquatic Resources

INTRODUCTION

A.5.108. The waters of the project area have been classified into 14 habitat types. Table A-5-7 lists these types and the acreages of each in 1980. For purposes of this study, the Lower Atchafalaya Basin Floodway has been separated into four aquatic habitat types: riverine, distributary or open-ended canals; freshwater bayou or slow-flowing canals; headwater lake; and backwater lake. This division is somewhat artificial because at high water, some bayous act as distributaries while at low water they are slow-flowing. Certain lakes, during high water, may have a headwater regime; while at other times flow enters them via backwater. Additionally, during much of the year cypress-tupelo swamps serve as aquatic habitat. In spite of the incongruities, the classification system is generally valid and provides a basis for comparison of habitats.

A.5.109. Prior to discussing the specific habitats, it may be appropriate to point out that the high productivity of the aquatic ecosystem of the Lower Atchafalaya Basin Floodway is directly attributable to the annual cycle of flooding and dewatering which normally occurs and to relate the typical sequence of events which are prevalent. The cycle starts with rising waters in the late winter and early spring. The bayous and lakes swell, overflow their banks, and spill into adjacent swamps and hardwood forests. As waters cover the forest floor, they flood the decomposing particles of plant material. Bacteria and fungi attach themselves to this detritus and break it down further. The detritus and its halo of organisms are eaten by detritovores, such as bullhead minnow (Levine, 1977), crawfish (Thomas, 1975), and numerous amphipods, ostracods, and cladocerans (Pennak, 1978). It is actually the halo of bacteria and fungi that is digested and the plant material is expelled as waste to be colonized by a new halo. The number of detritivores, especially,

zooplankton and crawfish, peaks in the spring when the amount of detritus is greatest. Breeding seasons of fish and many aquatic organisms coincide with the high water period. The expanded amount of habitat and vast amount of food available provide ideal conditions for birth, growth, and survival of young. The moving waters in the spring provide ample oxygen for developing organisms and prevent excessive deposition of sediment. During the summer, the waters fall, and fish are forced into permanent water bodies. Detritus is no longer flushed from the swamps and forests, but as the waters clear in the summer, high populations of phytoplankton occur. These serve as a food source and alleviate dissolved oxygen shortages that frequently occur in the summer. The newly dry forest and swamp floors are aerated and oxidized. This process releases nutrients which, in turn, are taken up by the vegetative ground cover that develops. In the fall the annual plants die, and the trees lose their leaves, thereby providing the source of detritus that will drive the system the following spring.

A.5.110. The following discussion describes the differences and similarities among the aquatic habitat classifications for the Lower Atchafalaya Basin Floodway. During the early 1970's, the Cooperative Fishery Unit at Louisiana State University (LSU) conducted a 3-year study of the limnology of the Atchafalaya Basin Floodway system (Bryan, et al. 1974, 1975, and 1976), which was concentrated in the Buffalo Cove area, the main river, and the Flat Lake/Duck Lake area (Figures A-5-10 and A-5-11). Unless otherwise noted, data cited for the floodway system are from these LSU reports. It is difficult to analyze the LSU data with respect to the aquatic habitat types in the floodway system that were considered in this study. In LSU's 1976 summary of physical and chemical data, only four parameters were displayed, bayous and swamps were combined, and no information was presented for backwater lakes. Therefore, to analyze seasonal trends for bayous and swamps, it was necessary to refer to LSU's 1975 report and utilize data on Little Bayou Sorrel and Buffalo Cove swamp. The LSU team did not report on true backwater lakes in the lower basin but studied one in the upper basin in late 1975. Then in 1977, LSU prepared a short report that summarized their chemical data in terms of the five aquatic habitat types considered in this study. Apparently, data utilized for this report were not included in any of their 1974, 1975, or 1976 reports. Thus, Tables A-5-12 through A-5-15 and the discussion on monthly trends for temperatures, dissolved oxygen, total phosphorus, and suspended solids are taken from data in the 1974-76 reports while discussion of other parameters and Table A-5-16 are taken from the 1977 report. In addition to the major classifications, other types of aquatic habitat encountered in the project area are addressed.

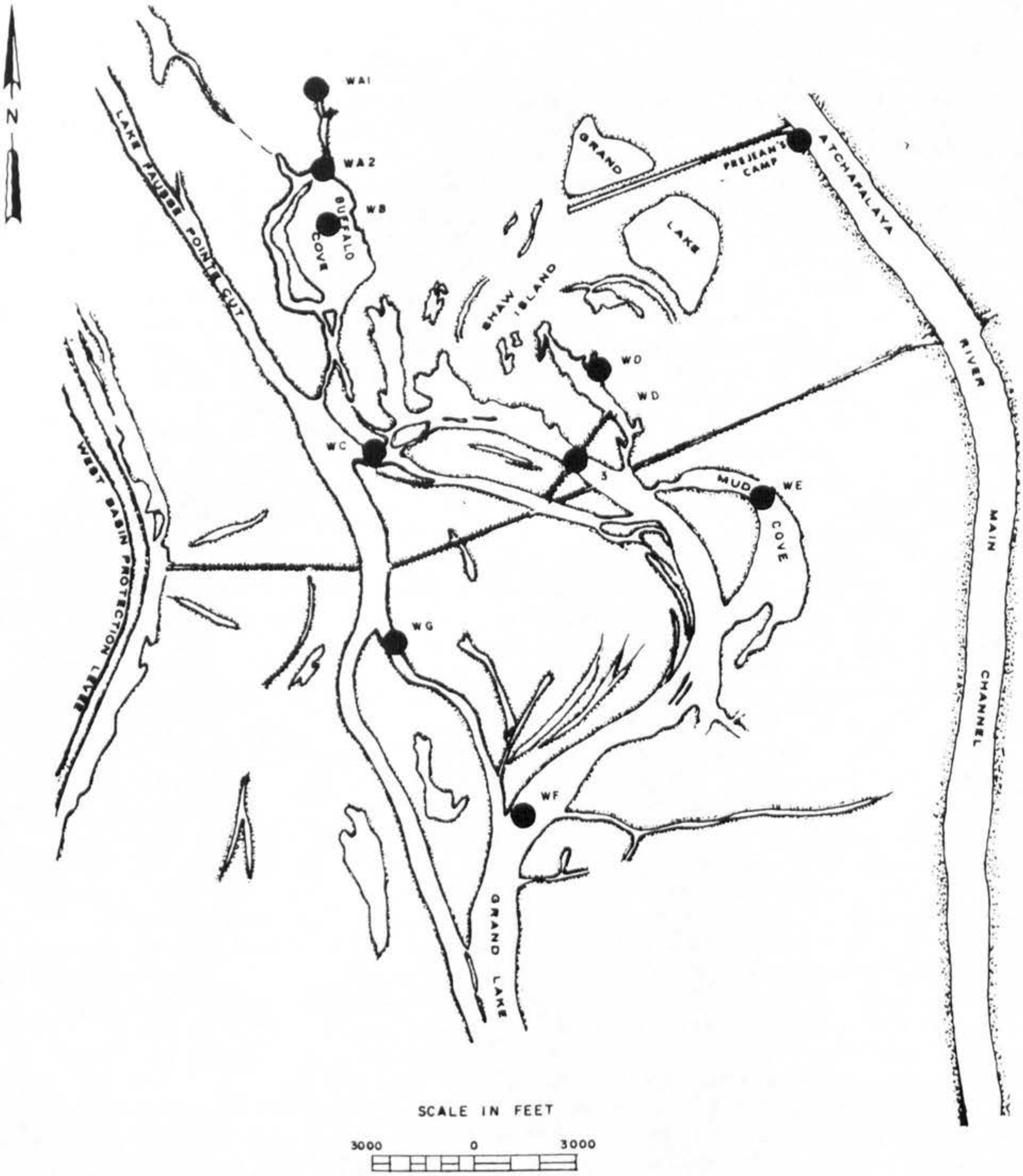


FIGURE A-5-10 LSU AQUATIC SAMPLING SITES

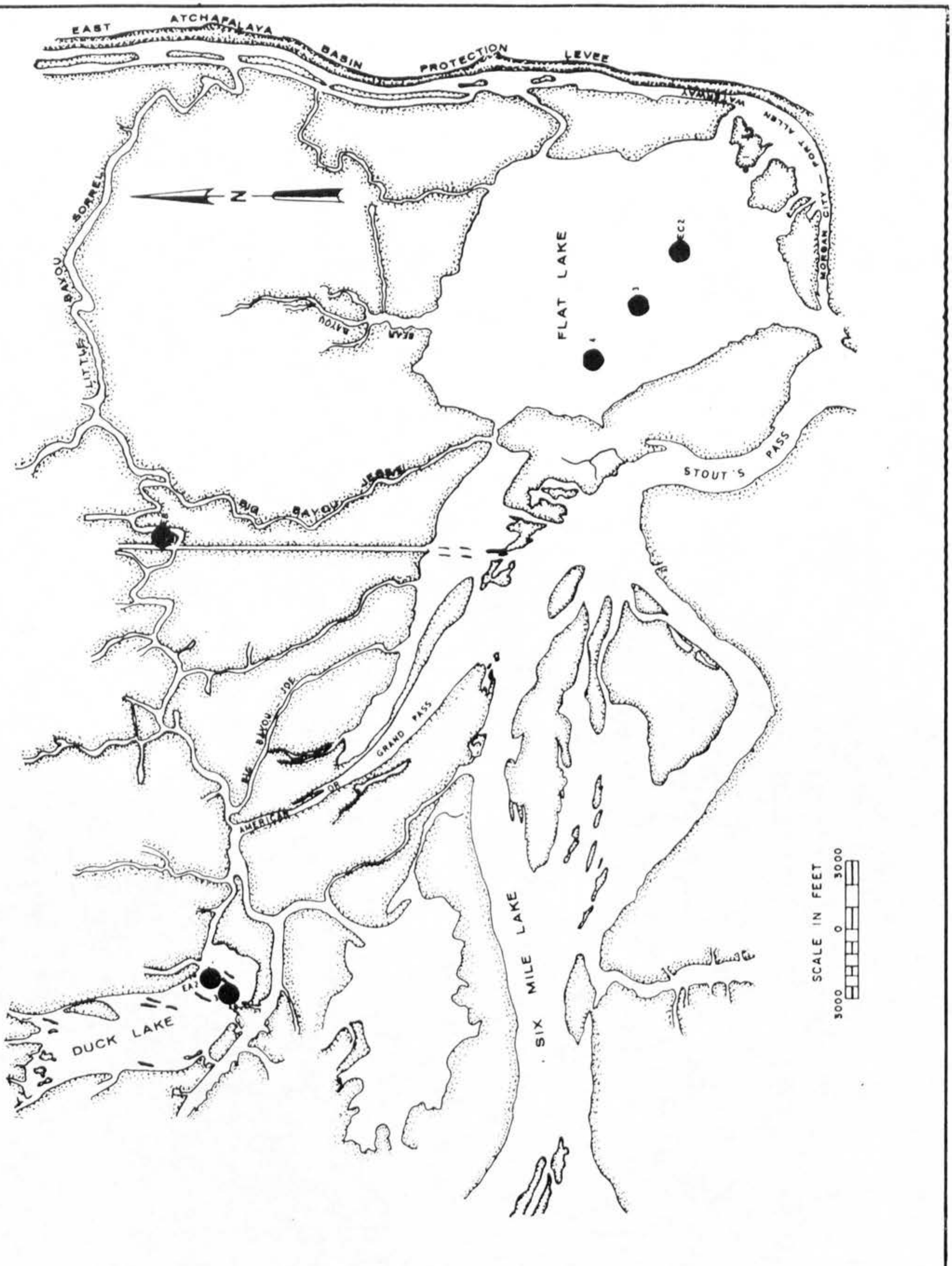


FIGURE A-5-11 LSU AQUATIC SAMPLING SITES

TABLE A-5-12

MONTHLY VARIATION IN TEMPERATURE IN °C
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES RIVERINE[1/] MEAN (RANGE)	BAYOUS[2/] MEAN (RANGE)	HEADWATER LAKES[3/] MEAN (RANGE)	SWAMPS[4/] MEAN (RANGE)
Sep 73	27.4 (27.0-28.0)	27.5 (27-28)	27.5 (24.5-28.5)	25.7 (24.2-27)
Oct 73	23.1 (19.4-27.5)	22.2 (20.5-23.5)	22.7 (21-30)	23.6 (20-28)
Nov 73	16.2 (12-19.3)	16.8 (13.5-19.5)	17.7 (14-20.5)	16.6 (15-19)
Dec 73	12.5 (11.5-13.0)	9.1 (3-13.5)	13.4 (11.5-14.5)	13.3 (12.5-13.5)
Jan 74	6.6 (4.5-9.0)	14.6 (14.2-15)	10.7 (6.5-15.2)	- - -
Feb 74	10.2 (9.0-12.0)	13.0 (13.0-13.9)	12.0 (11-13.5)	11.6 (11.5-12.0)
Mar 74	16.4 (15-18)	20.5 (19.8-21.2)	18 (16.5-21.8)	17.1 (16.5-18)
Apr 74	17.3 (15.8-20)	20.4 (19.8-20.5)	19.2 (18-21.5)	18.7 (18-19.1)
May 74	23.3 (21.5-25.5)	23.1 (22.5-23.5)	23.7 (22.5-25.5)	24.3 (23-25.5)
Jun 74	25.1 (24.5-26)	27.6 (27-28.5)	26.9 (25-30.5)	25.3 (23-29)
Jul 74	28.0 (25.5-29)	26.5 (25-28.2)	27.3 (25.5-29.5)	26.9 (25-28)
Aug 74	29.1 (26-32)	29.8 (28.5-32.0)	28.3 (25-34.5)	27.0 (25-29)
Sep 74	25.1 (23-26)	26 (24-27)	26.4 (24-29.5)	25.4 (23.5-29)
Oct 74	20.3 (18-22.5)	20.3 (18-23.5)	21.0 (18-24)	19.8 (17.5-22)
Nov 74	16.5 (13.5-19.1)	14.9 (13.6-16.5)	16.6 (14-19.2)	16.9 (16-18)
Dec 74	9.4 (8-11)	10.8 (10.5-11)	10.3 (9.0-11. 5)	9.8 (8.9-11)
Jan 75	9.7 (8-12.5)	11.1 (10.5-11.5)	10.4 (9.0-12.5)	- - -
Feb 75	12.4 (6.0-16.5)	16.0 (15-17)	12.9 (10.5-16)	- - -
Mar 75	13.3 (9.7-17.5)	14.0 (13.8-14.2)	13.7 (10.5-16.5)	- - -
Apr 75	14.8 (13-19)	- - -	14.6 (13-16)	- - -
May 75	23.0 (22-24)	- - -	23.3 (22.5-24)	- - -
Jun 75	26.0 (23.1-27)	- - -	26.7 (25.5-27.5)	- - -
Jul 75	28.8 (27.5-30)	- - -	28.5 (26-31)	- - -
Aug 75	26.7 (20.5-31.5)	- - -	31.5 (31-32)	- - -
Overall	20.5 (4.5-32)	19.9 (3-32)	20.6 (6.5-34.5)	19.6 (8.9-29)

1/ Mainstem at Simmesport, West Access Channel (RA) and Morgan City (RB).
2/ Little Bayou Sorrel (EB).
3/ Buffalo Cove Lake (WB), Duck Lake (EA), Flat Lake (EC), and Shaw Island Lake (WD).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-13

MONTHLY VARIATION IN DISSOLVED OXYGEN (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	RIVERINE[1/] MEAN (RANGE)	BAYOUS[2/] MEAN (RANGE)	HEADWATER LAKES[3/] MEAN (RANGE)	SWAMPS[4/] MEAN (RANGE)
	AQUATIC HABITAT TYPES			
Sep 73	6.6 (4.9-7.9)	3.9 (3.2-4.7)	5.2 (3.2-6.6)	3.0 (2.2-3.8)
Oct 73	6.7 (5.5-8.4)	3.8 (2.5-4.8)	6.1 (4.3-15.2)	4.6 (1.7-8.2)
Nov 73	7.4 (6.3-10.4)	4.4 (4.2-4.9)	5.7 (4.0-8.2)	2.9 (1.3-5.5)
Dec 73	7.4 (6.7-9.0)	4.6 (4.3-4.9)	6.2 (4.4-9.0)	4.5 (4.1-5.4)
Jan 74	12.0 (11.9-12.0)	5.1 (5.0-5.2)	9.0 (5.7-11.3)	- - -
Feb 74	7.2 (6.8-7.4)	5.9 (5.8-6)	6.6 (5.8-7.8)	6.3 (6.1-6.9)
Mar 74	8.6 (7.6-10)	3.8 (3.4-3.9)	7.1 (4.6-9.3)	5.0 (4.8-5.3)
Apr 74	6.5 (3.6-9)	2.8 (2.5-3)	5.6 (3.6-7.8)	4.5 (4.3-4.6)
May 74	5.2 (3.3-7.5)	1.8 (1.6-2)	4.1 (2.1-6.2)	2.8 (1.6-3.7)
Jun 74	5 (3.7-6.6)	1.2 (0.8-1.5)	2.9 (1.2-4.6)	1.2 (0-2.5)
Jul 74	4.5 (3.2-6.2)	0.9 (0.7-2.0)	2.2 (0.2-3.8)	0.6 (0.1-1.2)
Aug 74	4.4 (1.2-9)	3.8 (2.3-5.6)	3.8 (1.2-10.5)	0 (0-0)
Sep 74	6.1 (0.1-8.2)	2.1 (1.1-3.0)	5.3 (0-8.6)	5.7 (5.2-6)
Oct 74	5.6 (2.0-7.2)	3.9 (1.2-6.2)	4.2 (0.1-6.9)	0.8 (0-1.4)
Nov 74	6.6 (2.9-8.7)	4.6 (1.9-6.9)	6.4 (3.6-8.1)	6.8 (5.9-7.6)
Dec 74	8.9 (6.2-10.7)	4.7 (3.4-7.2)	7.6 (5.6-9.7)	5.4 (3.9-8.1)
Jan 75	8.6 (5.7-9.6)	4.1 (3.8-4.4)	7.8 (6.4-9.4)	- - -
Feb 75	8.2 (4.2-10.5)	4.4 (3.3-5.4)	7.8 (6.7-9.3)	- - -
Mar 75	7.7 (5.6-11)	2.8 (2.7-2.9)	7.8 (6.6-10.1)	- - -
Apr 75	7.2 (6.1-8.9)	- - -	7.0 (5.5-8.1)	- - -
May 75	4.9 (2.8-6.2)	- - -	3.9 (2.1-5.6)	- - -
Jun 75	3.7 (1.8-6.7)	- - -	2.9 (0.5-4.5)	- - -
Jul 75	4.2 (1.5-7.1)	- - -	2.6 (1.5-4.5)	- - -
Aug 75	6.3 (5.1-7.6)	- - -	3.5 (2 -5)	- - -
Overall	- (0.1-12)	3.6 (0.7-7.2)	(5.7 - 15.2)	4.2 (0 - 8.2)

1/ Mainstem at Simmesport, at West Access Channel (RA), and Morgan City (RB).
2/ Little Bayou Sorrel (EB).
3/ Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-14

MONTHLY VARIATION IN TOTAL PHOSPHORUS (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	AQUATIC HABITAT TYPES: RIVERINE 1/ MEAN (RANGE)	BAYOUS 2/ MEAN (RANGE)	HEADWATER LAKES 3/ MEAN (RANGE)	SWAMPS 4/ MEAN (RANGE)
Sep 73	0.06 (0.05-0.06)	- - -	0.07 (0.03-0.13)	- - -
Oct 73	0.44 (0.42-0.46)	0.16	0.25 (0.15-0.38)	- - -
Nov 73	0.32 (0.31-0.33)	0.10 (0.08-0.13)	0.17 (0.10-0.31)	0.06
Dec 73	0.51 (0.46-0.60)	1.10	0.21 (0.08-0.46)	- - -
Jan 74	0.28 (0.27-0.29)	0.06	0.16 (0.14-0.19)	- - -
Feb 74	0.18 (0.14-0.21)	0.11	0.12 (0.10-0.16)	0.14
Mar 74	0.23 (0.22-0.24)	0.11	0.15 (0.14-0.18)	0.15
Apr 74	0.27 (0.27)	0.08	0.12 (0.11-0.13)	0.13
May 74	0.14 (0.04-0.30)	0.10	0.14 (0.09-0.26)	0.07 (0.05-0.13)
Jun 74	0.38 (0.37-0.39)	0.04	0.10 (0.08-0.11)	0.10
Jul 74	0.28 (0.25-0.30)	0.03	0.09 (0.04-0.12)	0.12
Aug 74	0.12 (0.12-0.13)	- - -	0.10 (0.07-0.16)	0.07
Sep 74	0.12 (0.12-0.13)	- - -	0.31 (0.12-0.79)	0.20 (0.19)
Oct 74	0.25 (0.22-0.28)	0.11 (0.09-0.13)	0.13 (0.12-0.13)	0.20 (0.08-0.32)
Nov 74	0.36 (0.20-0.51)	0.08 (0.07-0.10)	0.14 (0.06-0.22)	0.13
Dec 74	0.30 (0.28-0.31)	0.03	0.11 (0.08-0.14)	0.08 (0.08-0.08)
Overall	0.23 (0.04-0.60)	0.14 (0.03-1.10)	0.15 (0.03-0.79)	0.11 (0.05-0.32)

1/ Fausse Point Cut (WC and WG) and Bayou Chene - Alligator Bayou.
2/ Little Bayou Sorrel (EB)
3/ Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-15

MONTHLY VARIATION IN SUSPENDED SOLIDS (MG/L)
IN THE ATCHAFALAYA BASIN FLOODWAY

DATE	RIVERINE 1/ MEAN (RANGE)	BAYOUS 2/ MEAN (RANGE)	HEADWATER LAKES 3/ MEAN (RANGE)	SWAMPS 4/ MEAN (RANGE)
	AQUATIC HABITAT TYPES			
Sep 73	358 (336-379)	- - -	29	- - -
Oct 73	288 (282-292)	- - -	131 (26-321)	- - -
Nov 73	545 (545)	381	105 (26-242)	72
Dec 73	242 (235-248)	- - -	208 (56-701)	- - -
Jan 74	149 (78-220	37	73 (25-105)	- - -
Feb 74	142 (137-146)	25	100 (37-138)	49
Mar 74	242 (233-250)	19	45 (33-62)	42
Apr 74	162 (118-205)	19	26 (15-31)	17
May 74	298 (297-298)	11	50 (24-67)	48
Jun 74	308 (290-327)	7	33 (22-45)	0
Jul 74	100 (78-122)	76	49 (17-84)	29
Aug 74	54 (43-65)	- - -	111 (94-130)	14
Sep 74	- - -	- - -	30 (27-33)	40
Oct 74	494 (211-776)	12 (6-18)	141	0
Nov 74	498 (437-523)	84 (81-88)	79 (20-154)	145
Dec 74	- - -	- - -	110 (93-142)	44 (42 - 47)
Overall	237 (43-776)	63 (6-381)	87 (15-701)	42 (0 - 145)

1/ Fausse Point Cut (WC and WG) and Bayou Chene - Alligator Bayou.
2/ Little Bayou Sorrel (EB).
3/ Buffalo Cove Lake (WB), Shaw Island Lake (WD), Duck Lake (EA), Flat Lake (EC).
4/ Buffalo Cove Swamp (WA).

TABLE A-5-16

PHYSICAL AND CHEMICAL PARAMETERS
IN THE ATCHAFALAYA BASIN FLOODWAY
AVERAGES AND RANGES

	AQUATIC HABITAT TYPES					
Parameter	Riverine	Bayous	Headwater Lakes	Backwater Lakes	Swamps	Cropland Lakes
Color	Turbid and muddy	Turbid during floods; tea-colored or black-clear at low flows	Turbid-green or turbid-brown	Turbid brown at high water; black-clear at low water	Clear brown to black	Pea-soup green to clear green
pH	7.5 (little variation)	7.2 (6.3 - 8.4) high in spring	7.5 (little variation)	7.1 (6.2 - 8.2) high in spring	7.2 (6.2 - 8.9) high in spring	7.7 (6.5 - 9.9) low in summer
Specific conductance (umkos/cm)	310 (104 - 705) high in summer	367 (168 - 3,285) high in spring	309 (104 - 705) high in summer	289 (130 - 505) high in summer	166 (56 - 465) high in summer	336 (43 - 651) stable
Oxidation - reduction potential (volts)	+0.551 (+0.028-+0.730) high in spring	+0.482 (+0.102-+0.740) high in spring	+0.554 (+0.028-+0.730) high in spring	+0.527 (+0.102-+0.770) high in spring	0.542 (+0.125-+0.880)	0.466 (+0.179-+0.810) high in winter
Nitrate nitrogen (mg/l)	0.60 (0.00 - 3.70) high in spring	0.20 (0.00 - 0.80) high in spring	0.35 (0.00 - 1.00) high in spring	0.30 (0.00 - 0.90) high in spring	0.35 (0.00 - 0.90) slightly higher in spring	0.20 (0.00 -0.25) much higher in spring
Organic C/ Organic N	135.0 (3.5 - 900.0) much higher in summer	35.6 (2.5 - 350.0) high in summer	122.0 (3.5 - 700.0) much higher in spring	189.0 (5.4 - 550.0) much higher in spring	27.0 (10.0 -80.0)	7.5 (1.1 - 16.0) much higher in spring
Total dissolved solids (mg/l)	190 (12 -385) slightly higher in summer	256 (100 - 850) high in summer	192 (86 - 264) high in spring	204 (129 - 412) high in spring	172 (143 - 238) very high in summer	208 (136 - 286) stable

Source: LSU, 1977.

ATCHAFALAYA RIVER, MAJOR DISTRIBUTARIES, AND MAIN STREAM LAKES

A.5.111. General. The Atchafalaya River, its major distributaries (Whiskey Bay Pilot Channel, the East and West Freshwater Distribution Channels, the East and West Access Channels, the Morgan City-Port Allen Waterway and Fausse Point Cut), and main stream lakes (Grand and Sixmile) comprise 23,000 acres of the 70,900 acres of purely aquatic habitat in the Lower Atchafalaya Basin Floodway. Thus, these riverine areas make up 35 percent of the floodway and are an even larger part of the permanent aquatic habitat. In the coastal area south of US Highway 90, this habitat type comprises 8,100 acres. These large channels are characterized by turbid, muddy waters with moderate to fast currents. The banks are usually steep except on the inside of bends where point bars accumulate. Sinuosity is generally minimal on such watercourses.

A.5.112. Physical and Chemical Characteristics. Tables A-5-12 through A-5-16 compare several physical and chemical parameters in the various aquatic habitats. The mean temperature of riverine waters generally drops below 10° Centigrade (C) in the winter and rises above 25°C in the summer (Table A-5-12). Riverine temperatures range from 4.5°C to 32°C and averaged 20.5°C in the LSU study. Riverine waters exhibit the lowest mid-winter mean temperatures of any aquatic habitat types, occasionally being as much as 8°C lower. During the spring, riverine temperatures are usually lower than all other habitat types. Mean temperatures during summer are similar to those in other habitat types while the summer range of fluctuations is less. Riverine waters consistently have the highest dissolved oxygen of all habitat types; levels range from a mean high of 12 milligrams per liter (mg/l) in the winter to a low of 4.2 mg/l in the summer (Table A-5-13). Levels approach saturation in turbulent waters when temperatures are lowest and discharge is highest and are usually more than 40 percent of saturation during low water periods. Total phosphate ranged from 0.04 to 0.60 mg/l and averaged 0.23 mg/l during the LSU study (Table A-5-14). Phosphates are generally lowest in the summer and highest in the early winter. Nitrate nitrogen is much higher in riverine habitats than in any others and the organic carbon to organic nitrogen (C/N) ratio is very high in riverine areas (Table A-5-16). LSU studies indicated that river waters are the main source of phosphorus and nitrogen for the primary production which occurs in the basin. Suspended solids are consistently highest in riverine waters ranging from 43 to 776 mg/l and averaging 237 mg/l (Table A-5-15). All these facts lead to the conclusion that the biological productivity of river water is low, especially in the winter, due to low temperatures, high turbidity, low habitat diversity, and swift currents.

A.5.113. Flora. The deep, swift, turbid riverine waters generally have few rooted aquatics except along the shoreline. Occasionally, water hyacinths and duckweed are present, having been washed out of the other areas. Phytoplankton is also sparse in riverine waters due

to turbidity, depth, and velocity. It is difficult to analyze seasonality of riverine plankton even though three studies considered it. The LSU group and Dotson (1966) found high fall peaks and spring lows (Table A-5-17), while Hern et al. (1978) indicated constant numbers throughout the year. In Dotson's 1964-65 study of the Sixmile Lake area, the filamentous green algae, Ulothrix and Mugeotia, and the unicellular Asterionella and Synedra were the most abundant. Bryan's group found the centric diatoms, Melosira and Cyclotella; the green, Scenedesmus, and the blue-green, Anacystis to be most common. The euglinoid Cryptomonas, and the diatoms, Melosira and Coscinodiscus, and Asterionella were the most abundant phytoplankton genera according to Hern et al. Floodwaters from the river appear to have a major influence on basin-wide phytoplankton. During high water periods when the entire basin is inundated, all habitats are fairly similar as phytoplankton and nutrients are transported throughout. As water levels fall, distinctive groups of phytoplankton become established in various habitats (Sager, 1976).

TABLE A-5-17

AVERAGE PLANKTON PER STATION PER MONTH

Month	Numbers Per Liter	
	Phytoplankton	Zooplankton
Sep 64	2,848	6,322
Oct 64	1,845	4,951
Nov 64	4,635	4,654
Dec 64	93	1,570
Jan 65	1,369	3,059
Feb 65	1,307	6,622
Mar 65	2,003	6,124
Apr 65	2,373	5,493
May 65	966	6,115

Source: Dodson (1966).

A.5.114. Phytoplankton in the basin does not form a major component of the food web because of its scarcity; however, it does play some role, especially in the summer. Rooted and floating aquatic plants serve as food and habitat for various fishes and shellfishes, as well as for higher vertebrates, such as waterfowl, and mammals, such as the nutria.

A.5.115. Zooplankton. During Dotson's 1964-65 study, he found microzooplankton to be more common than phytoplankton. The most abundant genus was the dinoflagellate *Peridinium*. Other abundant genera included the rotifers *Branchionus* and *Polyarthra*. Numbers per liter were low in the winter and high in the fall and spring (Table A-5-18). Holland (in Bryan et al., 1976) also studied microzooplankton and found the riverine community to be dominated by certain species of *Keratella* and *Branchionus*. Populations were highest in spring through fall and lowest in winter. Binford (1975) found the most abundant riverine macroplankton to be cladocerans, such as *Bosmina*, *Diaphanosoma*, and *Ceriodaphnia*; and copepods, such as *Diaptomus*. The riverine group generally peaked in March and April. Some of the most common genera peaked in the river after a peak in lakes and bayous, indicating that these genera were flushed out of lakes and bayous by the high river waters. Other genera peaked first in the river and were then dispersed into other habitats. Zooplankton are a vital part of the food web because they consume phytoplankton and detritus and, in turn, are devoured by larger organisms.

TABLE A-5-18

MONTHLY VARIATION OF PHYTOPLANKTON, ALL STATIONS COMBINED

Month	Numbers Per Liter
Mar 1974	36.2
Apr 1974	44.2
May 1974	41.7
Jun 1974	28.5
Jul 1974	34.6
Aug 1974	51.8
Sep 1974	127.9
Oct 1974	41.2
Nov 1974	39.2

Source: Bryan et al. (1975).

A.5.116. Benthos. Substrate and water velocity are the most important factors affecting benthic production. Riverine substrates are either hard clay or shifting sands. These habitats support a meager benthic fauna, especially the hard clay (Table A-5-19). Burrowing mayflies are the most abundant organism in this substrate. More organisms inhabit the sand. Groups such as tubificid worms and chironomids are common as are damselfly nymphs and Asiatic clams. The numbers of taxa are fairly constant throughout the year with a slight peak in November. The greatest number of organisms occurs in the early summer. River shrimp prefer this habitat and a commercial bait fishery exists for them. Blue crabs, mostly large males, are harvested in the summer by sport and commercial fishermen in the mainstream lakes. Crawfish are not present in large numbers in the riverine habitat although some are harvested from the mainstream lakes.

A.5.117. Fish. About 17 families containing some 45 species of sport, commercial, and forage fishes are present in the riverine habitat type. Most of the common fish species in the basin utilize these waters at some time in their lives. Certain shiners and chubs complete their life cycles in riverine areas. Blue and channel catfish spawn here and large numbers of juvenile catfish and freshwater drum utilize riverine channels as holding and feeding areas. Young-of-the-year of several species of sunfishes, crappies, and largemouthed bass are also present. Adult shad and adult and young skipjack, flathead catfish, and striped mullet are more abundant in this habitat than any other. Spotted and white bass are common and sought after by sport fishermen (Lambou, 1963). These riverine waters provide a valuable commercial fishery with the most important species being catfishes, buffalo, and freshwater drum (Bell, 1980). Catfish are taken with trotlines and hoopnets while buffalo and drum are caught with seines and hoopnets. Lesser numbers of gar, carp, bowfin, paddlefish, and striped mullet are sold for home consumption.

TABLE A-5-19

BENTHIC ORGANISMS
IN SELECTED HABITAT TYPES

Type	Number/square meter
Riverine	327
Dead end Canals	1,593
Headwater Lakes	1,840
Bayous	3,292
Swamps	3,768

A.5.118. Birds. Diving ducks, such as lesser and greater scaup, ruddy ducks, and redheads, utilize mainstream lakes during the winter. Bellrose (1976) reported that 38 percent of the Mississippi Flyway's 40,000 canvasbacks winter on or near Sixmile Lake; however, because sedimentation is decreasing the area of open water, the locus of these concentrations may be shifting to the Atchafalaya delta.

FRESH BAYOUS, CANALS, AND BORROW PITS

A.5.119. General. These waterways have a low current velocity except at high river stages and are much more sinuous than riverine channels. Bayou habitats comprise 38,000 acres of the project area. About 15,900 of these acres are in the Lower Atchafalaya Basin Floodway and 22,100 acres in the coastal area or backwater area northeast of Morgan City. Examples of typical floodway bayous are Little Bayou Sorrel, Little Bayou Pigeon, Bayou Postillion, and Alabama Bayou. Depths are usually less than 20 feet and often less than 6 feet. Shorelines are moderately steep where there is a substantial sediment load but are nearly indistinguishable from the swamp in some portions of the Upper Belle River area.

A.5.120. Physical and Chemical Characteristics. Bayou temperatures average 19.9°C and range from 3 to 32°C (Table A-5-12). Seasonal trends in bayous are similar to those in other aquatic habitats except that temperatures are higher in the spring. Dissolved oxygen generally follows the same seasonal trends as in other habitats, being highest in the winter and lowest in the summer (Table A-5-13), but bayou oxygen levels are consistently a few tenths of a mg/l lower than other habitat types. Dissolved oxygen concentrations average 3.6 mg/l and range from 0.7 to 7.2 mg/l. Oxygen percent saturation is 20 at low water and 90 during flood stages. Outflow of swamp waters or hurricane events have depressed oxygen levels sufficiently in bayous to cause fish kills. Total phosphorus averages 0.14 mg/l in bayous and ranges from 0.03 to 1.1 mg/l (Table A-5-14). Phosphorus tends to be high in the fall and low in the summer. Suspended solids are low in bayous compared to riverine habitats, averaging 63 mg/l and varying from 6 to 381 mg/l (Table A-5-15). Suspended solids are high in the winter and low in the summmer. Some bayous are very clear at low-flow periods. Dissolved solids are higher in bayous than in any other habitat types (Table A-5-16). In summary, bayous are less turbid than riverine waters, but also generally have less dissolved oxygen so fish kills are possible at certain times of the year.

A.5.121. Flora. Bayous with their slower currents often have rooted aquatics such as coontail, fanwort, and pondweeds at their edges. Duckweed, watermeal, and water hyacinth are distributed by bayous at high water. Phytoplankton in bayous are generally less diverse and numerous than in other habitat types. Average density and diversity

fluctuated drastically with little correlation to season in the study by Hern et al. (1978). This study found bayous to have low numbers and diversity in the summer. Other workers have found phytoplankton numbers and diversity to be highest in the summer. Green and blue-green algae and diatoms peak in the summer and early fall in bayou habitats, probably due to the clearness of the water at these times (Bryan et al., 1975 and Sager, 1976). The most common species are Scenedesmus, Anacystis, Melosira, and Cyclotella.

A.5.122. Zooplankton. The zooplankton of the basin appear to be divided into two recurrent groups: those that are associated with riverine waters and those associated with all other habitat types (Binford, 1975). As discussed in the previous section, some taxa, such as Bosmina and ostracods, peak first in bayous and lakes and are then swept out into riverine waters. Some other taxa are characteristic of the more lentic waters: the heavy cladocerans such as Alona and Ilyocryptus and the copepod, Eucyclops. These genera apparently need less oxygen than the riverine genera.

A.5.123. Benthos. Bayous with their detritus-rich substrates are moderately productive benthic habitats (Table A-5-19). Tubificid worms are the most abundant organisms and chironomids and clams are second in abundance. Species diversity is very high in bayous. Dead-end canals are classified with bayous but Beck (1977) found them to have lower numbers of organisms than bayous. Worms and Asiatic clams were the most common groups present. The greatest numbers of taxa occur in bayous in March and April and the greatest numbers of organisms in June. The low numbers in late summer are probably because most organisms cannot tolerate the low oxygen of that period.

A.5.124. Fish. The most common fish in the bayous include predators, such as spotted gar and bowfin; forage fish, such as gizzard shad; sport fish, such as largemouth bass, black crappie and bluegill; and commercial fish, such as carp, smallmouth buffalo, freshwater drum, and channel catfish (Sabins, 1977). Standing crop estimates vary from 1,014 pounds per acre in Little Bayou Pigeon to 837 pounds per acre in Bayou Postillion. Small fish, such as mosquitofish, pugnose minnows, and brook silversides, are also common in bayous, especially along the edges. Bayous serve as avenues for fish to move between riverine areas and lakes. During summers when water temperature becomes very high in lakes, fish will retreat to the deeper, cooler waters of the bayous during the day and then move out to forage in the lakes at night. Bayous are fairly permanent habitat and are where fish congregate as waters recede from the swamps and forests. Bayous in the backwater area northeast of Morgan City had standing crops varying from 106 pounds per acre to 307 pounds per acre in 1973 and 1979; shad, carp, and bowfin dominated the catch (US Department of Agriculture, 1979).

HEADWATER LAKES

A.5.125. General. Almost all of the 17,000 acres of headwater lakes in the project area are in the Lower Atchafalaya Basin Floodway below I-10. These lakes are generally long and fairly wide, ranging from 1 acre to several square miles in size. The distinguishing criterion for this habitat is complete flushing by flowing water during the spring months of an average water year. When the flow-through ceases, these lakes become stillwater lakes. Water depths during nonflood periods are usually less than 9 feet. Shorelines are gradually sloped and sometimes indistinct. Sediments are often fine sand, silt, and mud in mid-lake, grading to detritus near the shore. Examples of headwater lakes include Flat Lake, Duck Lake, and Grand Lake. This habitat type has a high productivity and great species diversity due to the addition of nutrients and oxygen during overbank flooding.

A.5.126. Physical and Chemical Characteristics. Headwater lakes show a moderate seasonal variation in mean temperature, varying from above 25°C in the summer to below 15°C in the winter (Table A-5-12). During the summer, lake waters occasionally heat above 34°C due to the absence of canopy and turbulence. Dissolved oxygen in headwater lakes is generally higher than in bayous or backwater lakes. It shows the same seasonal trends as in other habitats, peaking in the winter to above 6 mg/l and dropping below 3 mg/l in the summer. Mean dissolved oxygen is 5.7 mg/l and it ranges from 0 to 15.2. Exceedingly high dissolved oxygen levels occur in the early fall when suspended solids are low and photosynthesis is rapidly occurring. Suspended solids range from 15 mg/l to 701 mg/l, and average 87 (Table A-5-15). They generally peak in December and drop lowest in mid-summer. Total phosphorus is also highest in the winter and lowest in the summer. The mean for the year is 0.15 mg/l with ranges from 0.03 to 0.79 mg/l (Table A-5-14). Productivity is often high in these lakes because dissolved oxygen conditions are generally favorable, currents are slow to nonexistent during a large part of the year, and temperatures are high.

A.5.127. Flora. Headwater lakes receive turbid floodwaters which distribute floating aquatics, such as water hyacinth. As the waters recede, many of the hyacinths thus distributed begin to multiply and often completely cover some lakes during the warm months. The low suspended solids concentrations in the summer and the shallow nature of these lakes allow luxuriant growth of rooted aquatics in many areas. Alligatorweed, pondweeds, wild celery, fanwort, and naiads are common and provide habitat and food for fish and shellfish, as well as higher vertebrates, such as ducks and turtles. The water hyacinth roots also serve as an ideal substrate for many species of microscopic plants and animals which are important in the food web. During winter and spring when flooding inundates most of these lakes, the phytoplankton communities in all habitats are very similar (Sager, 1976). As water levels fall, habitats become distinguishable and

headwater lakes with their clear, nutrient-rich waters have an abundance of phytoplankton. Diatoms, such as Melosira and Cyclotella, are common but greens, such as Scenedesmus, blue-greens, such as Anabaena and Anacystis, and flagellates, such as Euglena become abundant (Sager, 1976). Hern's group also found a high diversity in phytoplankton in headwater lakes. Numbers of organisms per liter are highest in the summer (Bryan et al., 1975 and Hern et al., 1978).

A.5.128. Zooplankton. As discussed in the previous section, zooplankton populations in lakes and bayous are similar. Genera that are common in lakes include the cladocerans, Bosmina, Chydorus, and Alona and the copepod, Cyclops and ostracods. Population peaks generally occur in the winter and early spring and then the organisms are washed out of these areas into other habitat types. Some of the cladocerans peak, or have a secondary peak, in the summer during the time of high phytoplankton productivity (Binford, 1975).

A.5.129. Benthos. Lakes are only a moderately productive habitat in terms of numbers (Table A-5-19) but show the greatest species diversity in the basin (Beck, 1977). The most common organisms are snails, midges, and tubificid worms. Leeches and sponges appear to be restricted to headwater lakes. Grass shrimp are common among the rooted aquatics and are an important food item for various fish and birds. One of the most important benthic organisms in the basin is the crawfish. It is a major link that converts detritus and plant material to animal protein. The reproductive cycle of the crawfish is correlated with the hydrologic cycle. Females produce eggs in the summer and carry them until fall. Some adults then die while others burrow in the mud to escape dessication and predation. Juveniles usually overwinter in the water. As the waters rise in the late winter, adults and juveniles move out into the newly expanded habitats such as headwater lakes and swamps where they utilize the food and cover provided in these newly flooded areas. The headwater lakes provide excellent habitat for the red swamp crawfish and are some of the most productive areas during the harvest. It has been estimated that during the high water season, the basin may contain a standing crop of 1,000 pounds of crawfish per acre (Thompson, 1974). The peak harvest occurs in April and May. Areas along the protection levees are preferred habitat for white crawfish (Bryan et al., 1975). Crawfish are a principal component in the diet of numerous predatory organisms including blue catfish, yellow bullheads, and largemouth bass during high water; and bowfin and gar during low water (O'Brien, 1977). Flathead catfish, bluegill, and black crappie also eat crawfish. Additionally, crawfish are preyed on by terrestrial predators such as wading birds, reptiles, and raccoons.

A.5.130. Fish. Headwater lakes are fairly productive fish habitat. Approximately 14 families containing 41 species of fish are present in this habitat type. Among the more prominant forage fish are mosquito-fish, gizzard shad, striped mullet, bullhead minnows, silverband and

golden shiners, and silversides. Other small species are also found along the shorelines of lakes. Predators, such as bowfin and various species of gar, are common. Among the commercial fish, smallmouth buffalo, freshwater drum, carp, and yellow bullheads are the most abundant. These lakes appear to have an exceedingly high population of sport fish. Black crappie, largemouth bass, bluegill, warmouth, and redear sunfish are abundant. Rotenone studies conducted in 1975 and 1977 showed Grand Lake to have a standing crop varying from 352 to 480 pounds per acre with sport fish making up from 105 to 135 pounds of the total. These sport fish spawn in headwater lakes and young bluegill and warmouth utilize these lakes as a nursery. During LSU's study in the basin, they found the most productive fish habitat, in terms of taxa, to be areas adjacent to the protection levees. This is probably because of their sampling method, since seining was easily done there. Eight species of small fish were collected along levees. Such habitat is most logically classified with headwater lakes. Mosquitofish are abundant as are numerous darters, minnows, shiners, and madtoms. Juveniles of bluegill, warmouth, and other sunfishes reach their greatest concentrations there.

A.5.131. Reptiles and Amphibians. Shallow water bodies have the greatest species diversity of reptiles and amphibians (Keiser, 1976). These turtles, snakes, and frogs are an important link between terrestrial and aquatic ecosystems since they feed on aquatic organisms and, in turn, are often preyed upon by terrestrial species. Commercial frogging was once an important activity in the basin; however, it has declined significantly in recent years (Comeaux, 1972). The capture and sale of turtles is a long established industry in the basin. The primary species taken for human consumption include common and alligator snapping turtles, red-eared turtles, cooters, and sliders. The baby turtle market was once important but has declined since a Salmonella outbreak was traced to basin turtles.

A.5.132. Birds. Diving ducks, such as lesser scaup and redheads, utilize headwater lakes during the winter.

BACKWATER LAKES

A.5.133. General. Backwater lakes are water bodies that only receive a flow-through flushing of the river during the highest floods. Water levels are influenced mostly by precipitation and by waters backing into the area from downstream due to a high volume of water in the southern portion of the basin. Of the 79,000 acres of backwater lakes in the project area, 13,800 acres lie in the Lower Atchafalaya Basin Floodway and 28,200 acres in the backwater area northeast of Morgan City. Water depths are generally less than 6 feet and shoreline profiles are gradual. Substrate consists mainly of pulpy peats.

Typical examples are Cow Island and Lost Lake. Second Lake of the Bayou Petite Prairie system in the West Atchafalaya Floodway can also be classified as a backwater lake. Other lakes such as Bayou Darby, Murphy Lake, Henderson Lake and Buffalo Cove Lake function as backwater lakes during much of the year but during periods of average flooding, they receive some flows through. Very little work has been done in these areas; therefore, the data base for comparison with other habitat types is meager. In the backwater area northeast of Morgan City, Lakes Verrett and Palourde and Grassy Lake have been classified as backwater lakes because at high river stages, water flows back into these areas.

A.5.134. Physical and Chemical Characteristics. Data for this section is taken only from the LSU 1977 report. Temperatures range from 9°C to 32°C and averaged 19.9°C. Dissolved oxygen ranges from 0 to 120 percent saturation and averages less than 50 percent saturation overall. Levels are often at only 20-30 percent saturation at low water. Suspended solids range from 18 to 701 mg/l and average 119 mg/l. Levels are slightly higher during high water. Specific conductance is fairly low in backwater lakes. In summary, backwater lakes are generally less valuable aquatic habitat than headwater lakes because the dissolved oxygen is generally less and nutrients, in general, are more scarce. Backwater lakes may be more valuable than headwater lakes in terms of sport fish production.

A.5.135. Flora. Rooted aquatics, such as coontail, fanwort, alligatorweed, and water willow are common, especially in the summer as the waters become clear. There is very little data on phytoplankton populations in backwater lakes. Hern et al., (1980) found *Melosira* and *Skeletonema* to be the most common in Henderson Lake. The greatest numbers of individuals occurred in the winter. Lantz (1974) found green algae to predominate in Henderson Lake phytoplankton while LSU (1977) reported phytoplankton to be reduced in backwater lakes with green algae and diatoms being present in similar proportions.

A.5.136. Zooplankton. As discussed previously, zooplankton populations in lakes, bayous, and swamps are all quite similar. *Daphnia* and ostracods dominate the zooplankton (LSU, 1977).

A.5.137. Benthos. Communities are characterized by phantom midges and tubificid worms (LSU, 1977). Red swamp crawfish, chironomids, and clams were found to be common by Lantz (1974).

A.5.138. Fish. Data on fish from these areas are sparse. In Big Alabama Bayou, bluegill, mosquitofish, and silversides are common. Largemouth bass and gizzard shad are also present (Sabins, 1977, unpublished). Lantz (1974) found Henderson Lake to have standing crops varying from 255 pounds per acre in 1967 to 504 pounds per acre in 1970. Gizzard shad dominated the catches, with largemouth

bass, bluegill, channel catfish, and black crappie being common. Lake Verrett was found to have approximately 150 pounds per acre in 1973 and 1978; bluegill, shad, and carp dominated the catch (US Department of Agriculture, 1978).

CYPRESS-TUPELO SWAMPS

A.5.139. General. Swamps function as aquatic habitat during much of the year and thus must be considered as part of the aquatic ecosystem. Water depths are usually less than 3 feet and there is no well-defined shoreline. Bottoms are usually composed of clays and peats. The Buffalo Cove swamp is an example of this habitat type. There are 176,000 acres of swamp in the Lower Atchafalaya Basin Floodway, and 275,000 acres in the backwater area northeast of Morgan City and in the coastal area. This habitat type is very similar to the backwater lakes previously described because many swamps receive most of their water via the backwater route.

A.5.140. Physical and Chemical Characteristics. Swamps have the narrowest range of temperature because they are remote from the cooling influence of the river (Table A-5-12). Temperatures average 19.6°C and range from 8.9° to 29°C with highs occurring in the summer and fall, and lows in the winter. These swamps often have the lowest dissolved oxygen levels in summer months of any habitat type (Table A-5-13). Moving water generally provides the oxygen in the basin and during much of the year swamps are essentially stagnant, hence the low oxygen. Even at high water levels, swamps often have lower oxygen levels than other habitats. Dissolved oxygen can fall precipitously as the swamp floods and the plant material from the previous year is decomposed. As this low oxygen water comes out of the swamps, it can cause fish kills in adjacent habitat types. Suspended solids in swamps are generally slightly higher than those found in bayous and lower than those in headwater lakes. Total phosphorus appears to fluctuate through the year and is in the same range as in bayous and headwater lakes (Table A-5-14). Conductivity is lower in swamps than in any other habitat type (Table A-5-16). In summary, even though swamps can have low dissolved oxygen, they are extremely valuable habitat during high river stages because of the additional space they provide.

A.5.141. Flora. Rooted aquatics are not abundant. Coontail is occasionally present. However, water hyacinths and/or duckweed often cover great expanses of swamp especially in the southern part of the floodway. As floodwaters recede in the summer, a characteristic phytoplankton assemblage differentiates in the swamp. Diatoms such as Cyclotella and Melosira; blue-greens, such as Anacystis; and flagellates such as Euglena, Glenodinium, and Chlamydomenas appear to prefer this habitat and are rare in other areas (Sager, 1976).

Seasonal trends are similar to those in other habitat types with a peak in the summer and low in the winter. Hern et al., (1978) found the number of organisms per liter to be very high in the northern end of Buffalo Cove Lake, basically a swamp.

A.5.142. Zooplankton. Swamp zooplankton populations are generally similar to those in lakes and bayous. Ubiquitous genera, such as *Bosmina* and *Daphnia* are common as are ostracods.

A.5.143. Benthos. Swamps with their rich detrital substrate are the most productive benthic habitat in the basin (Bryan et al., 1976 and Beck, 1977). Annual spring flooding and flushing of accumulated detritus from swamps is an important factor in this productivity. The number of groups of organisms and total number of organisms in swamps peak in January and February. These parameters peak in bayous and riverine habitats in February through May and in lakes in the summer. These facts appear to indicate that benthic organisms are flushed out of the swamps and into the rest of the basin by floodwaters. Benthic organisms show the highest density and a high diversity in swamps. Major groups of organisms are equally represented, which indicates a degree of habitat stability. Clams, fly larvae, and isopods are the most abundant organisms. One reason for the high diversity is the large numbers of water hyacinths. These floating plants support a large, diverse community including amphipods, isopods, mayflies, and snails. Seasonality of hyacinth-clinging organisms is dependent on water levels and oxygen. Numbers are high throughout the spring and early summer when there is ample dissolved oxygen, then populations drop abruptly in the late summer as water and oxygen levels fall and the hyacinth mat sinks. As the mats rise with floodwaters in the winter, benthic numbers increase as the hyacinths are washed out into the lakes and bayous. Then when freezing weather comes and the hyacinths die, all the benthic organisms are added to the bottom community. Hyacinths thus provide cover for large numbers of benthic organisms, as well as for numerous fish. The red swamp crawfish reaches its highest productivity in these swamps due to the large acreage available in which to hide and forage.

A.5.144. Fish. The most common forage fish in swamps include pugnose and bullhead minnows, silversides, and juvenile shad. These fish often concentrate around the edges of the hyacinth mat. Sport fish, such as bluegill, warmouth, redear and spotted sunfish, largemouth bass, and black and white crappie, spawn in swamps. Juveniles utilize the area as a nursery, and large numbers of adults are also present. Yellow bullhead and blue catfish are common.

CROPLAND LAKES

A.5.145. General. There are approximately 6,000 acres of cropland lakes in the project area. The majority of these 6,000 acres lie in

the Red River backwater area, only 27 acres are presently found in the Lower Atchafalaya Basin Floodway. These are an important habitat type for this study, because if clearing for agriculture occurs in the basin, the few remaining headwater and backwater lakes will become classified as cropland lakes when they become surrounded by soybean fields. For this study, a cropland lake is defined as a lake which is entirely surrounded by agricultural lands and receives runoff from these lands. Such lakes are moderately deep and are generally eutrophic due to the agricultural runoff. Banks are usually steep and lined with a narrow band of cypress or bottomland hardwoods. A typical cropland lake is the upper portion of the Bayou Petite Prairie system in the West Atchafalaya Floodway.

A.5.146. Physical and Chemical Characteristics. Temperatures average 23.1°C and range from 7.7° to 34°C. Dissolved oxygen averages greater than 75 percent saturation and ranges from 0 to 200 percent. Suspended solids average 31.2 mg/l, range from 1 mg/l to 78 mg/l, and are highest during low water. Cropland lakes are more alkaline than in any other habitat.

A.5.147. Flora. Aquatics are generally not common and consist mostly of alligatorweed and coontail. Standing stocks of phytoplankton are highest of all habitats sampled. Green algae were most abundant with diatoms and blue-greens a close second.

A.5.148. Zooplankton. Microzooplankton numbers are exceptionally high in these lakes; however, species diversity is lower than in other habitat types. Data on macrozooplankton are unavailable.

A.5.149. Benthos. Benthic communities are dominated by clams but worms and midges are also abundant.

A.5.150. Fish. Forage fish, such as minnows, silversides, topminnows, and darters, are present. Shad and striped mullet are abundant. The common sport fish are largemouth bass and crappie. Bluegill and other sunfish are generally too small to enter the sport fishery. The commercial fishery is dependent on carp, buffalo, bowfin, and gar. Generally, species diversity is lowest in cropland lakes.

FRESH MARSH PONDS AND LAKES

A.5.151. General. Fresh marsh ponds cover 87,600 acres in the project area and all lie south of the ridge formed by Bayous Teche and Black. These marsh ponds are water bodies defined to be less than 64,000 acres and are valuable habitat for waterfowl, wading birds, and furbearers. Wintering ducks and geese prefer fresh marsh water bodies over more saline area and congregate on these ponds in great

numbers. Dabbling ducks are most likely to be found in fresh ponds. Tidal action from both lunar and wind-driven tides regularly raises and lowers water levels in these ponds even though they are some distance from the gulf. Depths are usually less than 5 feet and they are surrounded by fresh marsh plants. Typical fresh marsh ponds include Lake Gasha, Avoca Island Lake, and Lake Salve.

A.5.152. Physical and Chemical Characteristics. Suspended solid concentrations generally are highest in the winter and spring when discharge from the Atchafalaya River is the greatest. However, some ponds in the northern fresh marsh in Terrebonne Parish are removed from direct river influence by the existing Avoca Island levee and suspended solid concentrations in these ponds are lower than in the fresh marsh ponds to the south and west. During the winter and spring, dissolved oxygen levels in most fresh marsh ponds are high because of the influence of the oxygenated river water. Values seldom fall below 5 mg/l and usually remain at 80-90 percent saturation. During the summer and fall, levels of oxygen are lower but anoxic conditions rarely occur because mixing and circulation takes place due to tides and winds. Salinities in these fresh ponds range between 0.09 and 10 ppt but are generally less than 6 ppt (Chabreck, 1972).

A.5.153. Flora. These ponds are generally fairly clear from late spring through the fall and attached aquatics, such as spike rush, pond weeds, coontail, and fanwort, often attain luxuriant growth in them. Floating aquatics, such as water hyacinth and duckweed, are also common. Green algae, such as *Cladophera* and *Spirogyra*, commonly form floating mats in such ponds. Phytoplankton similar to that present in lakes in the basin would be present with populations peaking during the low turbidity summer months. The floating and attached plants are utilized as food for waterfowl and as cover and food for numerous fish and invertebrates. Phytoplankton plays an important part in the base of the food web.

A.5.154. Zooplankton. Zooplankton are generally abundant in these nutrient-rich ponds. Cladocerans, such as *Simocephalus* and *Daphnia*, and the copepods, *Cyclops*, *Macrocyclops*, and *Eurytemora*, are common. During high water periods, riverine zooplankton would predominate in these ponds. These zooplankton are an important part of the food web.

A.5.155. Benthos. The benthos of fresh marsh ponds is similar to that of headwater lakes and plays a vital role in the food web. Snails, midges, tubificid worms, and amphipods predominate. River shrimp are often common in these ponds.

A.5.156. Fish. Fresh marsh ponds are highly productive for fish. Fish of both fresh and estuarine affinities utilize these water bodies. Small fish, such as mosquitofish, least killifish, rainwater killifish, sailfin molly, and sheepshead minnow, are present in the shallows and among the aquatics. Anchovies utilize the ponds as a

nursery area. Sport fish, such as bluegill, redear sunfish, and largemouth bass, are common. Catfish are often abundant as are freshwater drum.

FRESH BAYS

A.5.157. General. Fresh bays are defined as water bodies greater than 64,000 acres in extent. There are 200,000 acres of this habitat type in the project area, including Atchafalaya Bay and West Cote Blanche Bay.

A.5.158. The fresh bays are a major component of the dynamic estuarine complex that stretches from Morgan City to the gulf. Freshwater and estuarine forms utilize the area in a constantly changing interplay as they move in and out under the influence of the varying salinities and temperatures. These bays are also exceedingly valuable habitat for wintering waterfowl. Both dabbling and diving ducks frequent them. Depths are usually from 2 to 8 feet. Bay bottoms are predominantly silty clay and clayey silt (Barrett, 1975).

A.5.159. Physical and Chemical Characteristics. The chemistry of these bays is heavily influenced by the Atchafalaya River and Wax Lake Outlet for 8 months of the year. Temperatures in fresh bays drop lower than in other bays due to the cool river water and are always lower near the river mouths. Annual water temperature near the Lower Atchafalaya River averages 15°C, while in West Cote Blanche Bay it often averages 7°C warmer (Juneau, 1975). However, bay waters are warmer than waters in the floodway. Suspended solids are greatest during periods of high river discharge in the winter and spring. In the summer prevailing southerly winds often maintain moderately high suspended solid levels. The river also influences bay salinities which average 2.9 parts per thousand (ppt) and range from 0 ppt to 13 ppt. Salinities are near zero in April and May and reach their high in later summer (Juneau, 1975 and Hoese, 1976). Dissolved oxygen levels in fresh bays are relatively high and do not vary significantly on an annual basis (Juneau, 1975). This high oxygen level is due to shallowness, fetch, tide, wind action, and river influence.

A.5.160. Flora. Attached aquatics are present in fresh bays although not in the high numbers as in marsh ponds. Wild celery, pond weed, naiads, and spike rush can all be found in these bays. Floating aquatics, such as water hyacinth and duckweed, are sometimes carried into fresh bays by the river. The phytoplankton is dominated by the river community of Melosira and Cyclotella in the winter and spring and by an estuarine assemblage of Scenedeamus and Nitzschia in the summer (Bryan et al., 1976). Blue-green algae often form mats on the shallow bottoms of these bays. The aquatics are heavily utilized by ducks while the phytoplankton plays a vital role at the base of the

estuarine food web. Inland waters, such as fresh, brackish, and saline bays, have been shown to export detritus to the gulf (Gosselink and Cordes, 1979).

A.5.161. Zooplankton. The zooplankton of the fresh bays is dominated by riverine forms, such as Simocephalus and Daphnia, during winter and spring. During low water periods a more estuarine assemblage, consisting of crab zoea, grass shrimp larvae, and the common copepods, Acartea and Labidocera, is present (Juneau, 1975, and Bryan et al., 1976).

A.5.162. Benthos. The most common organisms in Atchafalaya Bay are burrowing amphipods of the generus Corophium. Chironomid worms are common in the northern portions of fresh bays. Large numbers of road clams, Rangia cuneata, are present in muddy substrates. Snails, such as the marsh periwinkle and Vioscalba, occur regularly. Juvenile white shrimp utilize these bays in large numbers in fall (Juneau, 1975). River shrimp are often abundant in fresh bays. Commercially important blue crabs and white shrimp species utilize fresh bays as nursery areas. The road clam shells are harvested in Atchafalaya Bay for use as a gravel substitute.

A.5.163. Fish. Forage fish common in fresh bays include gizzard shad, silversides, striped mullet, freshwater gobies, and most common of all, anchovies. All the species of freshwater fish present in the basin are also present in the fresh bays; largemouth bass, sunfishes, and yellow bass. Striped bass are found in the winter. During the summer, estuarine sport fish, such as red drum, black drum, southern flounder, and Atlantic croaker, utilize these fresh bays. A valuable commercial fishery exists in these fresh bays for gar, catfishes, and buffalo in the winter; and bull sharks, drum, croaker, spot, and seatrout in the summer. Fresh bays are utilized as nursery areas by such species as southern flounder, menhaden, Atlantic croaker, and spot (Bryan et al., 1976).

BRACKISH PONDS AND LAKES

A.5.164. General. There are 55,200 acres of brackish ponds in the project area. Lost Lake and Lake Mechant are characteristic. These ponds are generally less than 5 feet deep. Water levels are affected by river discharge as well as by lunar and wind driven tides.

A.5.165. Physical and Chemical Characteristics. Concentrations of suspended solids are generally quite low in these ponds. Dissolved oxygen is usually more than 5 mg/l. Salinities ranges from 6 ppt to 18 ppt with the higher salinities occurring in the summer and early fall. Temperature ranges in ponds are greater than in adjacent brackish bayous.

A.5.166. Flora. Attached aquatics, widgeon grass, spike rush, and Eurasian watermilfoil, are common in these ponds (Chabreck, 1972). Salinities are too high for floating aquatics. Green algae, such as Enteromorpha, and blue-greens, such as Oscillatoria, often form floating mats or carpets on the bottom. Diatoms often encrust any firm substrate. Phytoplankton is generally abundant and estuarine genera, such as Nitzschia, Skeletonema, and Chaetoceros, are characteristic (Simmons and Thomas, 1962).

A.5.167. Zooplankton. Characteristic estuarine zooplankton, namely the copepods, Acartia and Labidocera, crab zoea, mysids, clam larvae, ostracods, and arrowworms are present in brackish ponds during most of the year. During periods of high river discharge, freshwater genera described in previous sections are present.

A.5.168. Benthos. Brackish ponds generally have a rich and diverse benthic fauna comprised of amphipods, copepods, mud crabs, numerous species of snails and clams, and polychaete worms. Brown and white shrimp and blue crabs utilize these ponds as a nursery area with brown shrimp being common in the summer. Oysters are also common.

A.5.169. Fish. Forage fish, such as sea catfish, lady fish, Atlantic needlefish, shipjack herring, menhaden, and anchovies, are common in brackish ponds. The shallows and grass beds are inhabited by small fish, such as sailfin mollies, sheepshead minnows, and gulf killifishes. Sport fish caught in these ponds include spotted seatrout, red drum, southern flounder, Atlantic croaker, and spot. Commercial fishermen harvest many of these same species. These ponds serve as a nursery area for numerous species of sport and commercial importance, such as drum, seatrout, and flounder. However, it must be remembered that the basis of the estuarine food web is detritus, which is produced mainly in the marshes. Turner (1979) has shown that the Louisiana commercial inshore shrimp catch is directly proportional to the area of intertidal wetlands and not to the area of estuarine waters. Thus, as marshes subside and erode to become ponds, a vital portion of the system is lost.

BRACKISH BAYOUS

A.5.170. General. There are 6,200 acres of brackish bayous in the project area. Depths in these bayous are generally less than 9 feet and often less than 5 feet. Most bayous are sinuous and have no distinct banks but grade into the adjacent brackish marsh. Tidal action, as well as river discharge affects water levels. Currents are generally sluggish.

A.5.171. Physical and Chemical Characteristics. These bayous generally have low suspended solid concentrations because many of the

solids have been deposited in fresher areas. Dissolved oxygen levels are usually greater than 5 mg/l throughout the year. Salinities are influenced by the flow of the Atchafalaya River and by the gulf and vary from 6 ppt in the winter to 18 ppt in the summer. Temperature ranges are usually less than in fresher bayous and are also less than in adjacent ponds. Thus, at times of extreme temperatures, bayous serve as a refuge for organisms to escape the heat or cold.

A.5.172. Flora. Attached aquatics, such as widgeongrass and spike rush, are present along the banks of brackish bayous. Floating aquatics are absent. Green and blue-green algae form mats on the edges of these bayous. Phytoplankton is dominated by freshwater genera for a short period during high riverflows, but most of the year estuarine phytoplankton genera, such as *Nitzschia* and *Chaetoceros*, dominate.

A.5.173. Zooplankton. Brackish bayou zooplankton is essentially similar to that previously described for brackish ponds.

A.5.174. Benthos. The muddy bottoms of brackish bayous are inhabited by the same organisms described in the previous section on marsh ponds. Bayous are used by numerous organisms, especially brown and white shrimp, as passages between bays and ponds. Barnacles attach to any hard substrate in bayous, such as pilings.

A.5.175. Fish. The same species mentioned previously in the section on brackish ponds are present in brackish bayous.

A.5.176. Mammals. The Atlantic bottle-nosed dolphin may be present in brackish bayous.

BRACKISH BAYS

A.5.177. General. Brackish bays comprise 58,900 acres in the project area. Typical brackish bays include Four League Bay and the southern portion of East Cote Blanche Bay. Water levels in these bays are affected by wind and lunar tides but rarely by river discharge. Depths range from 2 to 8 feet in general and bottoms are of silty clay or clayey silt (Barrett, 1971) and often have concentrations of detritus. Diving ducks utilize these bays.

A.5.178. Physical and Chemical Characteristics. Conditions are similar to those previously described in brackish marsh ponds. However, temperature ranges are generally less than in ponds and turbidity is often higher due to wind mixing.

A.5.179. Flora. Flora is generally similar to that in brackish ponds. Rooted aquatics are normally less numerous because depths are somewhat greater in bays.

A.5.180. Fauna. Fauna of these brackish bays is generally similar to that in the brackish ponds. Oyster leases cover most of these brackish bays and ponds in Terrebonne Parish. Since the bays are generally deeper and more closely connected to the gulf, large marine fish, e.g. sharks, are more often present in bays than in ponds. Bays also serve as a vital nursery area for many fish and shellfish of sport and commercial importance. Juvenile brown shrimp heavily utilize them in the summer. The commercial harvest attributable to all marsh water bodies in the project area was calculated by Lindall et al., (1972) and has been modified for Table A-5-20.

SALINE PONDS AND LAKES

A.5.181. General. Saline ponds make up 64,417 acres of the project area. Tides raise and lower the water level daily. Typical saline marsh ponds are Caillou Lake and Bay Junop. Bottoms are generally comprised of silty clay and depths are usually from 2 to 5 feet.

TABLE A-5-20

COMMERCIAL PRODUCTION (IN POUNDS) OF MAJOR ESTUARINE DEPENDENT COMMERCIAL FISHERIES BY HYDROLOGIC UNIT (1963-1977)

SPECIES	UNIT V 1/	UNIT VI 2/	UNIT VII 3/
Menhaden	82,810,000	28,320,000	52,630,000
Shrimp	26,540,000	2,010,000	2,790,000
Croaker	8,680,000	1,100,000	2,410,000
Blue Crab	1,820,000	286,000	160,000
Oysters	1,130,000	- -	290,000
Seatrout	397,000		168,000
484,000			
Spot	1,700,000	214,000	570,000
Red Drum	189,000	5,000	5,000

1/Bayou Lafourche to eastern edge of Atchafalaya Bay.
2/Atchafalaya Bay.
3/East and West Cote Blanche Bays, Vermilion Bay to Freshwater Bayou Canal.

Source: Lindall et al. (1972), modified.

A.5.182. Physical and Chemical Characteristics. Suspended solid concentrations are generally low in saline ponds in the winter and high in the summer (Gosselink et al., 1979). Dissolved oxygen rarely falls below 5 mg/l. Salinities average greater than 18 ppt. Temperature ranges are similar to those in brackish ponds and are generally greater than in adjacent saline bayous.

A.5.183. Flora. There are essentially no attached aquatics in saline ponds. Filamentous algae, such as Enteromorpha and Anabaena, are found in such ponds. Phytoplankton play an important role with Coscinodiscus, Asterionella, and Navicula being common (Green, 1976).

A.5.184. Zooplankton. During the summer, zooplankton populations generally peak. Characteristic organisms are the copepods Acartia, Tortanus, Temora, and Labidocera; the cladocerans Evadne and Podon; arrowworms, crab zoea, comb jellies, and oyster and snail larvae. (Gillespie, 1971, and Barrett et al., 1978).

A.5.185. Benthos. Saline ponds also have a rich and diverse benthic fauna. Polychaete worms, razor clams, blue crabs, hermit crabs, fiddler crabs, mud crabs, and oyster drills are all common. Salinities are too high to produce healthy oysters due to the presence of the oyster drill.

A.5.186. Fish. Forage fish, such as menhaden, anchovies, pinfish, and silversides, are common inhabitants of saline ponds. Sport fish are numerous in saline ponds with spotted and sand seatrout, red and black drum, southern flounder, Atlantic croaker, and spot being harvested. These same species are caught by commercial fishermen. Both adults and young of these species utilize the ponds.

SALINE BAYOUS

A.5.187. General. There are approximately 6,100 acres of saline bayous in the project area. Some of these bayous are shallow, ranging from 3 to 5 feet deep while others, especially those connecting a bay or pond with the gulf, are up to 20 feet deep due to the action of tidal currents. Bottoms are generally clayey silt to silty clay.

A.5.188. Physical and Chemical Characteristics. These parameters are generally similar to those described under saline ponds. However, the deeper bayous are cooler in summer and warmer in winter and thus serve as a refuge for organisms. Suspended solid concentrations are usually higher than in saline ponds.

A.5.189. Flora. The same phytoplankton, filamentous algae, and unicellular algae as occur in saline ponds, occur here.

A.5.190. Fauna. Zooplankton, benthos, and fishes are generally similar to those described in saline ponds. The deeper, wider passes have a characteristic benthic community of brittle stars, sea urchins, and sand dollars. Atlantic bottlenose dolphins are common in saline bayous and passes.

SALINE BAYS

A.5.191. General. Approximately 53,800 acres of saline bays are present in the project area. These bays range from 2 to 6 feet in depth and bottoms are generally silty clay or sandy silt (Barrett et al., 1971). Caillou Bay and Terrebonne Bay are some of the saline bays in the project area.

A.5.192. Physical and Chemical Characteristics. Conditions are very similar to those previously described for saline ponds. Turbidity is occasionally higher than in ponds and temperature ranges are less than in ponds.

A.5.193. Flora. Saline bay flora is very similar to that existing in saline ponds. Beds of shoal grass and turtle grass are often found in protected areas on the north side of barrier islands. These grass beds are prime nursery habitat for young of many species, including spotted seatrout.

A.5.194. Fauna. Fauna is similar to that described for saline ponds. More gulf fishes and shellfishes are present in the saline bays than in saline ponds because of the easy access from the gulf. Saline bays are also a nursery area for numerous fish and shellfish important to human beings.

OPEN GULF

A.5.195. General. There are approximately 804,000 acres of open gulf in the project area. Since the gulf itself will be only minimally impacted by the project, only a brief description of its flora and fauna is necessary. The gulf in the project area varies from the shoreline to a depth of 22 feet. Bottoms are mainly sand, but silt and clay bottoms also occur.

A.5.196. Physical and Chemical Characteristics. Suspended solid levels are very low in gulf waters much of the year. However, during periods of high river discharge, levels rise especially near shore. Temperatures vary with depth and season. Salinities are generally near 32 ppt except at times of high river discharge. Gulf salinities in portions of the project area located south and southwest of Atchafalaya Bay are much lower than those outside of the river's

influence. For example, salinities in the shallow gulf waters east of Four League Bay, which are not greatly influenced by Atchafalaya River discharge, are considerably higher than those west of Four League Bay.

A.5.197. Flora. The clear gulf waters have a moderately rich phytoplankton fauna, including genera such as *Coscinodiscus*, *Skeletonema*, and *Chaetoceros*.

A.5.198. Zooplankton. A variety of organisms comprise the gulf zooplankton. Copepods, such as *Acartia*, *Tortanus*, and *Temora*, are common, but large numbers of crab zoea, shrimp larvae, arrowworms, and oyster and snail larvae are present.

A.5.199. Benthos. The benthos of the gulf is exceedingly varied and communities can be differentiated on the basis of substrate and depth.

A.5.200. Fish and Other Marine Vertebrates. There are numerous kinds of fish, such as groupers, jacks, pompano, tuna, marlin, and tarpon in the gulf that do not occur, or rarely occur, in estuaries. Nearly all the species previously discussed under brackish and saline areas are also present in the gulf. Numerous shore birds, whales, porpoises, and sea turtles also utilize this habitat.

Cultural Resources

A.5.201. Archeological surveys in the Atchafalaya Basin have resulted in the discovery of hundreds of sites. To date, these surveys have been predominantly site specific; that is, they have concentrated on known sites and have not been directed toward a thorough search of known or suspected cultural areas. Systematic and thorough surveys, which should correct this situation, have been relatively few in the study area. Additionally, thorough on-the-ground search of certain localities is not a foolproof method of discovering all or even most archeological sites. No evaluative program has been tried which would give information about the representativeness of the site sample compared with the number of sites (e.g., buried by alluviation, etc.) that are really present. Because many surveys were guided by aims other than the production of site distributional information, they have not been effective in collecting archeologically useful data on siteless (or presumed siteless) areas, an absolute necessity to analyses of spatial distributions. The site distribution pattern in the Atchafalaya Basin is a pattern produced by intensive efforts in a few corridors, preconceived assumptions by investigators, and the masking of the terrain by geomorphic activity (in some cases, mound sites 3 to 6 meters high reported in 1913 have disappeared). It is not a pattern that truly reflects the dispersion of archeological sites and should not be regarded as such.

A.5.202. Some 252 sites have been recorded (taken from site map files of the State Division of Archaeology and Historic Preservation and US Army Corps of Engineers, New Orleans District) in the Atchafalaya Basin area. A discussion of the nature of these sites follows.

THE NATURE OF ARCHEOLOGICAL SITES IN THE BASIN

A.5.203. The archeological sequence for southeastern Louisiana in which manifestations exist are generally organized into six major units. A brief summary of these divisions follows (modified from Newman, 1976).

A.5.204. Paleo-Indian (10,000 B.C. - 6,000 B.C.). Diagnostic traits include bifacially chipped, lanceolate projectile points with or without flutes extending up from a straight or concave base, along the longitudinal axis of the points. The fluting may be bifacial or unifacial.

A.5.205. Subsistence economy was based on hunting and gathering. Excavated sites reveal artifacts in association with terminal Pleistocene megafauna.

A.5.206. The settlement pattern, revealed in archeological deposits, generally consisted of small temporary campsites near or along the edges of springs.

A.5.207. Archaic (6,000 B.C. - c. 550 B.C.). Diagnostic traits include a greatly expanded chipped stone and ground stone inventory, common throughout the Archaic, and includes medium to large stemmed, triangular projectile points, side and end scrapers, perforators and drills, bifacial 'knives', ground stone beads, celts, plummets, steatite vessels and effigies. Clay figurines and shell ornaments, an expanded bone industry that includes antler atlatl hooks and bone awls, a wide range of baked clay objects, and the importation of exotic raw stone material were added by the terminal Archaic Poverty Point culture group.

A.5.208. Subsistence economy consisted of hunting, gathering, and collecting. No physical evidence of a cultivated or domesticated food base is known.

A.5.209. Settlement patterns of this period include large earthworks at the Poverty Point site, West Carroll Parish, comprised of a mound and concentric semi-circular ridges that were occupied. A low-domed, earthen tumulus was tested on Avery Island; also, several campsite deposits of this period were examined in the Lake Pontchartrain area. A series of seven low earthen mounds built in a circular

pattern is known as the Pickett Island site, Catahoula Parish. At the Monte Sano Site, East Baton Rouge Parish, excavations revealed remains of a structure having a square floor pattern. An earthen midden located on an inset terrace remnant is present to the west of the Atchafalaya Basin in St. Landry Parish.

A.5.210. Tchefuncte (c. 550 B.C. - A.D. 250). Diagnostic traits of the Tchefuncte culture include the first major introduction of pottery. Vessels are conical with multi-form, tetrapodal bases. Incised, brushed, punctated and stamped decorative motifs appear on the vessel bodies and rim exteriors. A thick, red slip is present on some plain vessels. Decorated tubular, clay pipes are also introduced. Chipped and ground stone, bone and shell implements, and baked clay objects are common. These latter forms are similar to those of the terminal Archaic period, but are generally less plentiful, variable, or ornate.

A.5.211. Subsistence economy during the Tchefuncte period consisted of hunting, gathering, and collecting, with a probable trend toward broad-spectrum subsistence pursuits, which include a cultivated and possibly domesticated food base. Indications of horticulture can be seen in Tchefuncte deposits at the Mortin Shell Mound, Iberia Parish and the Bayou Jasmine site, St. John the Baptist Parish.

A.5.212. The settlement pattern exhibited during this period consists of numerous sites in the marsh areas of southern Louisiana that are characterized as shell and organic middens. Inland sites most numerous along the prairie terrace to the west of the Atchafalaya Basin (Teche-Vermilion Watershed), principally consist of small, low, earthen mounds, and middens. Gibson (1980) has confirmed Tchefuncte presence in the basin at several sites including 16 IV 4 (Bayou Sorrel Mounds).

A.5.213. Marksville (A.D. 250 - A.D. 700). Diagnostic traits of this culture include new pottery types comprised of bowls, globular and jar-shaped vessels that are elaborately decorated on the exterior with punctated, incised and stamped motifs. Vessels may also be decorated with red pigment and stylized zoomorphic motifs. Ground stone and ceramic platform pipes and effigies are present. Artifacts of exotic raw materials including copper, quartz crystals, asphaltum and galena are often present in sites of this period.

A.5.214. Subsistence economy during this period consisted of broad spectrum hunting and collecting, augmented by a probable domesticated food base. Evidence of corn and squash are purported from the Marksville site, Avoyelles Parish.

A.5.215. Settlement patterns are somewhat varied; one extensive occupation, the Marksville site, consists of a group of earthen mounds within a semicircular, ridged, earthen wall. Domed mounds contain a

central chamber for the disposal of the dead. Human interments, both primary and secondary, are deposited along with a selected quantity of pottery, chipped and ground stone, bone, shell, and copper funerary offerings. Other sites consist of middens and/or mounds with no visible evidence of palisades or enclosures. Evidence of a possible habitation structure, rectangular in plan with a semisubterranean floor, was exposed at the Marksville site.

A.5.216. Troyville-Coles Creek (A.D. 700 - A.D. c. 1100). Diagnostic traits of this culture include the introduction of clay as a ceramic tempering agent; also the development of new decorative designs and vessel shapes is characteristic of this period. Simple incising on a wide variety of rims marks the earlier forms, while incising, punctating, and check-stamping become dominant later. This period is also marked by an expansion in bowl and platter (plate) vessel shapes. Elbow-shaped clay pipes, ear spools, and grinding stones become important features. Toward the end of this period, the preponderance of small, finely chipped projectile points probably indicates the introduction of the bow and arrow, whereas previously the atlatl predominated.

A.5.217. The subsistence economy was based upon corn and squash agriculture; subsistence pursuits were supplemented by broad-spectrum hunting and gathering.

A.5.218. The settlement pattern is characteristically three large, pyramidal, compound mounds oriented around an open plaza. Houses have either rectangular or oval floor patterns. Mounds of the Troyville site, Catahoula Parish, were within a large, rectangular ditch (moat) and earthen enclosure. Multiple primary and secondary human interments, generally without artifactual associations, are common features in the mounds.

A.5.219. Plaquemine - Mississippian (A.D. 1100 - A.D. 1700). Diagnostic traits include new ceramic typologies, shell-tempered pottery, effigy vessels, new decorative motifs, strap handles, effigy pipes, and ear spools which characterize this period. Complicated stamped designs are present during the earlier phases, with curvilinear designs predominating later. Late in the period, native artifacts are found in association with European trade goods. "Southern Cult" artifacts are also present in some sites.

A.5.220. Subsistence economy was primarily corn, bean, and squash agriculture that was supplemented by seasonal hunting and collecting.

A.5.221. The settlement pattern consisted of large, compound, pyramidal mounds oriented around an open plaza, characteristic of the larger sites. Mounds may have stepped ramps. Round, rectangular and square structure floor patterns, with or without wall trenches. Some villages are surrounded by wooden palisades. Secondary single and

multiple bundle burials occur in the mounds. Primary, flexed, human interments are also present. Gibson (1980) makes a strong case that the Chitimacha Indian village of Ama' tpan na' mu is at the site of 16 SMY 2 (Charenton Beach).

A.5.222. The preceding categories are generalizations of "cultures" and types of sites to be found in the Atchafalaya Basin. The number of previous archeological investigations within and near the Atchafalaya Basin give the impression that the prehistory of the great swamp is well known. This is simply not the case. The above presentation is an illustration in itself of one problem in the archeology of the basin. To describe the archeology of the basin requires the imposition of culture sequences originated in regions outside the basin and adoption of several concomitant assumptions about culture processes, assumptions whose validity for archeological reconstructions may be questioned.

A.5.223. When Indians first moved into the Atchafalaya Basin is open to considerable conjecture. As a matter of fact, the topic cannot even be considered until one specifies which paleogeographic stage of basinal development is being discussed.

A.5.224. No residues from Paleo-Indian activities are known within the present-day Atchafalaya Basin. But does this imply their absence or merely that the land surfaces that might have borne these evidences have been eliminated or buried by river channel shifts since Paleo-Indian times? Characteristic Paleo-Indian artifacts, mainly projectile points, have been found on Godeau Hill and Evergreen Island on the western edge of the modern Atchafalaya Basin. They seem to be associated with a relict, resculptured Mississippi River meanderbelt (i.e., the Lafayette-Mississippi meanderbelt), which has been entirely obliterated from the contemporary surface of the Atchafalaya Basin.

A.5.225. A similar conclusion can be reached concerning Archaic components. Although Archaic sites have been identified in the upper part of the basin, they all seem to lie along older, elevated landforms that have remained relatively untouched by subsequent degradation or aggradation within the swamp itself. One such component is site number 16 AV 33. Superficially, 16 AV 33 appears to be connected with the Bayou Jack segment of the Teche-Mississippi course that Saucier (1974) believed to have been active about 6,000-4,000 B.C. However, sediments and soils at the location hint of a far more complicated geomorphic picture, one that may have involved an ancestral meanderbelt of the Arkansas River. Archaic sites are densely located along the exposed natural levees of Big Darbonne Bayou, implying that the bayou was a significant water course during an earlier phase of its existence. Gagliano et al., (1978) suggests that Big Darbonne Bayou may have been a major crevasse system off the Teche-Mississippi system.

A.5.226. South of US Highway 190, no Archaic sites have been identified within the basin proper, although they do parallel the swamp margins atop the Mississippi alluvial valley walls themselves. In other words, they overlook the swamp but seemingly do not extend out into it. This may seem unusual because the Teche Ridge, the elevated meanderbelt of the Teche-Mississippi River system, which apparently supports Archaic components in the upper reaches of the Atchafalaya Basin, is well preserved to the vicinity of modern-day Berwick and Morgan City.

A.5.227. Until Gibson's (1980) survey of the East-West Atchafalaya Protection Levees, it was believed that Tchefuncte settlements were also missing in the Atchafalaya Basin. Now it is known that they do exist. They appear in high densities along the western edge of the basin flanking the Bayou Jack, Bayou Rouge, and Petite Prairie meanderbelts. From Bayou Courtableau (US Highway 190) south to Berwick, near the southern end of the swamp, they seem to be more scattered but are nonetheless present. This survey, in fact, confirmed Tchefuncte components on the eastern flank of the Teche Ridge at Bayou Perronet (16 SM 50), Charenton Beach (16 SM 2), and Mocassin (16 SMY 104). The Lake LaRose Mounds (Moore 1913), in the middle of the swamp about 12 kilometers (km) southeast of Bayou Perronet, may also have a Tchefuncte component. On the eastern perimeter of the basin, Tchefuncte occupation may be present at Bayou Sorrel Mounds (16 IV 4) and the Schwing Place (Moore, 1913). Both of these sites, however, appear to be positioned atop stable, elevated, remnant landforms, presumably formed by early Mississippi River alluviation, perhaps the Maringouin-Mississippi River. By normal archeological criteria, Poverty Point components are difficult to identify in many localities in south central Louisiana. This is probably a function of distance (300-400 km) from the Poverty Point localities on the Macon ridge in extreme northeastern Louisiana and western Mississippi where typological details for culture unit attribution were originally extracted. Population enclaves in south central Louisiana, which were contemporary with the Poverty Point developments upvalley, were simply doing things in their own time-honored, traditional manner that had proved adaptively successful to them and their ancestors. However, by stretching typological criteria and emphasizing the presence of exotic trade materials, it is possible to ascribe some Atchafalaya edge components to the Poverty Point culture period. The Stelly mound group on Bayou Petite Prairie, near the Bayou Jack-Bayou Rouge meander complex (Teche-Mississippi meanderbelt), seems to be a local center of activities during Poverty Point times. Farther down the valley escarpment in the vicinity of Lafayette, Louisiana, there is another cluster of sites, which temporarily and, to an attenuated degree, culturally equate to the Poverty Point culture period.

A.5.228. There are similar typological and interpretive problems found in dealing with the Marksville, Coles Creek-Troyville, and Plaquemine-Mississippian "cultures."

A.5.229. In short, very little is known about substantive prehistory in the Atchafalaya Basin and, in many cases, what is known is not based on findings from the basin proper but from outside regions so distinctive from the swamp that applicability may be questioned. Virtually every aspect of Atchafalaya prehistory is at issue, from chronological segmentation and culture unit systemization to simple descriptive and reconstructive categories dealing with settlement subsistence and higher-order levels of cultural interest. Because the state of understanding is so germinal and the technical problems with acquiring representative information are so numerous, it would be pretentious to claim that the Atchafalaya Basin has contributed greatly to the explication of culture change, evolution, and historical events among native American populations in the Lower Mississippi Valley.

A.5.230. It does appear certain that the uniqueness of the region demands unique archeological perceptions and interpretations. Thus great care must be exercised in determining the significance of sites and their disposition.

FOLK CULTURE

A.5.231. A unique folk culture based upon exploitation of swamp resources developed in the basin in the mid-1800's. Although some swamp dwellers spoke English, most were French-speaking Acadians. Agricultural pursuits on the natural levees of Bayous Chene and Sorrel in the basin began in the early nineteenth century. The extractive economy emerged in the basin as the result of many historical factors. Many of the original Acadian settlers of southwestern Louisiana were dislocated by expansion of the Anglo-plantation system and forced to reside on low natural levees in the swamp. The marginally successful agriculture in the basin was disrupted by the Civil War and the clearing of the Raft (1840-1861). The basin's inhabitants first supplemented their garden foods and many turned completely toward extraction of wild resources, such as crawfish, moss, cypress, fish, frogs, etc.

NATIONAL REGISTER SITES

A.5.232. The National Register of Historic Places as published in the "Federal Register," dated 6 February 1979, and the monthly supplements through 28 September 1981, have been consulted and two archeological sites, which are located within the Atchafalaya Basin Floodway, have been determined eligible for inclusion in the National Register. The Nutgrass site, 16SM45, is an important shell midden located on the west bank of the Port Allen-Morgan City Intracoastal Canal south of Belle River Landing, Louisiana. Subsequent to its determination of eligibility to the National Register, the Nutgrass site was protected from further erosion in 1975 by placement of stone on the bank and

adjacent underwater slope by the US Army Corps of Engineers. An intensive cultural resources survey of the Atchafalaya Basin Floodway Levees was conducted by the University of Southwestern Louisiana in 1979 - 1980, and located eleven (11) significant cultural resources possibly eligible for inclusion in the National Register. One (1) of these, the Avoca Island Pumping Plant Number 1 (16 SMY 52), was determined eligible for inclusion on 14 September 1981. Upon a slight modification of project design, a determination of no effect was completed on 14 September 1981. Additionally, numerous historic resources located on the Bayous Grosse Tete, Lafourche, and Teche natural levee ridges bordering the Atchafalaya Basin have been included in the National Register of Historic Places.

NATIONAL TRUST PROPERTIES

A.5.233. The only National Trust property located in Louisiana is Shadows-on-the-Teche, located on Bayou Teche in Iberia Parish west of the Atchafalaya Basin. Built between 1831-1834 in New Iberia, it is a two-story, porticoed mansion with eight giant Tuscan columns and a second floor veranda.

HISTORIC SITES

A.5.234. In addition to the National Register and National Trust properties mentioned, over one-quarter of the 252 sites previously stated contain historic components. Even larger numbers can be anticipated, as historic sites have not received the attention accorded to prehistoric sites.

A.5.235. The considerable number of ship disasters and military sinkings of vessels during the Civil War point to a high probability of encountering subsurface or underwater ship remains. A reliable listing of ship losses has yet to be assembled.

Human Resources

A.5.236. The socioeconomic information on the study area is the aggregate for the area comprised of the following Louisiana parishes: Assumption, Avoyelles, Caldwell, Catahoula, Concordia, Franklin, Iberia, Iberville, Lafourche, La Salle, Pointe Coupee, Ouachita, Richland, St. Landry, St. Martin, St. Mary, Tensas, Terrebonne, and West Baton Rouge. The economic study area is shown on Figure A-5-12.

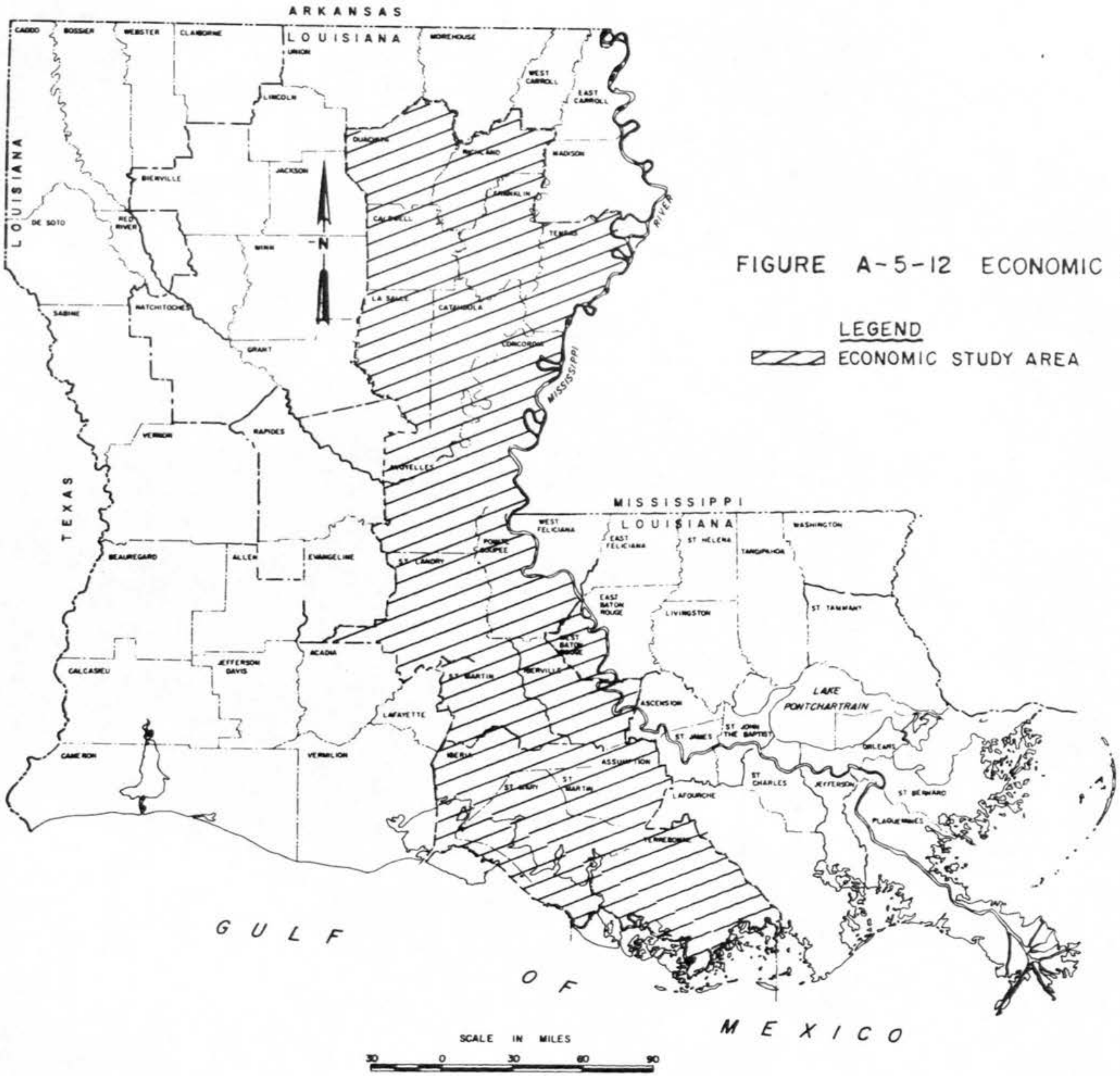


FIGURE A-5-12 ECONOMIC STUDY AREA

LEGEND

ECONOMIC STUDY AREA

Population Characteristics

A.5.237. In 1970 the population contained within that portion of the Atchafalaya Basin Floodway system not protected by ring levees was approximately 4,600 with the heaviest concentration consisting of scattered developments in the West Atchafalaya Floodway, extending along the alluvial bank of the Atchafalaya River. Additional small settlements of camp-type homes are situated in the Lower Atchafalaya Basin Floodway at Butte La Rose and on the floodway side of the levees in the general vicinity of Morgan City.

A.5.238. As shown in Table A-5-21, the population within the economic study area has increased from 575,000 to 757,000 persons during the 25-year period from 1950 to 1975. This increase represents an annual compound growth rate of 1.1 percent as compared with the Louisiana and national rates of 1.4 percent for the same period. The 1950-60 decade was the period of most rapid growth. During that time, the population grew at a 1.5 percent rate. This rapid population growth coincided with burgeoning development of coastal Louisiana's onshore and offshore petroleum resources. Since 1960, the increase has slowed to an annual rate of about 0.8 percent.

A.5.239. Between 1950 and 1960, the economic area as a whole experienced net out-migration at a rate of 8.9 percent. Net migration varied by parish between minus 31.0 percent to 11.6 percent; two-thirds (2/3) of the parishes had net out-migration. Generally, net out-migration occurred from the interior parishes as a result of the decreased demand for agricultural workers and a general trend toward migration to large urban areas outside the economic area. Coastal parishes experienced net in-migration during this decade as a result of increased demand for labor in connection with petroleum exploration, production, and related service activities. In the decade of the 1960's, the net migration rate for the economic area registered minus 9.4 percent. Net migration rates ranged between minus 34.7 and 0.8 percent; net in-migration was experienced in only two parishes, both of which contained significant petroleum production. While continued net out-migration has generally occurred within the study area since 1970, its magnitude seems to have decreased from previous levels. Between 1970 and 1975, the economic area as a whole experienced net out-migration at a rate of 2.9 percent. Net migration rates varied by parish between minus 9.9 to 6.5 percent with only five of the parishes having net in-migration.

A.5.240. In 1970, the population of the economic area was classified as 46 percent urban, and over 27 percent of the total population resided in eight urban centers: Eunice (11,390); Houma (30,922); Monroe (56,374); Morgan City (16,586); New Iberia (30,147); Opelousas (20,121); Thibodaux (14,925); and West Monroe (14,868). It should be

TABLE A-5-21

POPULATION DATA
(In Thousands)

Parish	Total Population 1950	1960	1970	1975	Net Migration Rate 1/ 1950-60	1960-70	1970-75
Assumption	17,278	17,991	19,654	20,419	-16.1	-8.7	-3.8
Avoyelles	38,031	37,606	37,751	38,171	-20.5	-12.1	-3.8
Caldwell	10,293	9,004	9,354	10,156	-25.9	-3.8	-5.7
Catahoula	11,834	11,421	11,769	11,397	-25.8	-11.5	- 8.9
Concordia	14,398	20,467	22,578	21,628	-10.5	- 9.0	- 9.9
Franklin	29,376	26,088	23,946	23,523	-33.6	-21.2	- 7.0
Iberia	40,059	51,657	57,397	61,096	- 2.0	-10.5	- 0.8
Iberville	26,750	29,939	30,746	30,601	- 7.9	-13.0	- 5.8
Lafourche	42,209	55,381	68,941	72,445	3.9	0.8	- 1.8
LaSalle	12,717	13,011	13,295	14,619	-15.6	- 8.9	- 6.5
Ouachita	74,713	101,663	115,387	125,447	11.6	- 3.5	2.6
Pointe Coupee	21,841	22,488	22,002	21,855	-22.1	-21.1	- 5.6
Richland	26,672	23,824	21,774	21,683	-23.7	-34.7	- 4.5
St. Landry	78,476	81,493	80,364	80,553	-21.9	-19.4	- 6.4
St. Martin	26,353	29,063	32,453	34,436	-16.7	- 7.8	- 1.1
St. Mary	35,848	48,833	60,752	60,680	- 9.1	0.7	- 7.3
Tensas	13,209	11,796	9,732	8,723	-31.0	-28.9	-15.5
Terrebonne	43,328	60,711	76,049	81,791	7.2	- 1.7	1.3
West Baton Rouge	11,738	14,796	16,864	17,522	1.7	- 8.4	- 2.7
TOTAL	575,123	667,292	730,808	756,745	- 8.9	- 9.4	- 2.9
LOUISIANA	2,683,516	3,257,022	3,641,306	3,791,000	- 1.9	- 4.0	- 1.0

1/ Net migration represents the difference between the number of persons moving into a particular area and the number of persons moving away from the area. Net migration was estimated by subtracting natural increase (the difference between the number of births and deaths) from the net population change.

Source: US Department of Commerce, Bureau of the Census, "County and City Data Book, 1977."

noted that the major urban centers of Lafayette (68,908) and Baton Rouge (165,963) are located adjacent to the economic study area.

A.5.241. The study area comprises 29 percent of total land in the State of Louisiana and accounted for 20 percent of its population in 1975. This area is a significant part of Louisiana as it contains almost one-third of total state land and nearly one-fourth of the entire population.

MAJOR SKILLS AND OCCUPATIONS

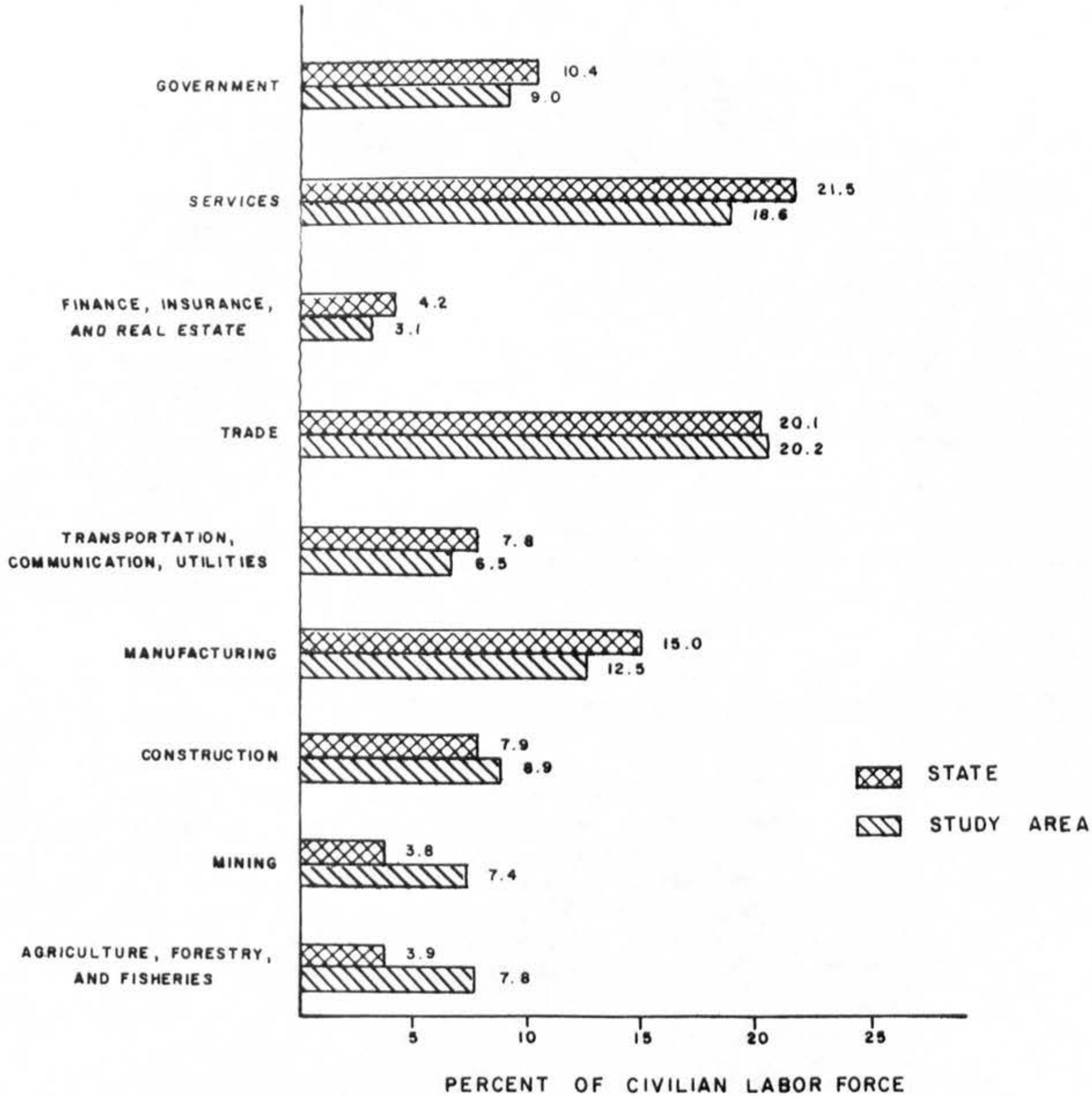
A.5.242. Study area employment in 1970 was concentrated in trade, services, manufacturing, government, construction, agriculture, forestry, fisheries, and mining. Jobs in transportation, communications, utilities, finance, insurance, and real estate were also extant in 1970, but to a lesser degree than those previously discussed. Study area employment was more concentrated in agriculture, forestry, fisheries, and mining in 1970 relative to comparable statewide data. About 24.1 percent of the study area civilian labor force was employed in these industry sectors while the statewide average was about 15.6 percent.

A.5.243. The percentages of the population employed in major skills and occupations in the state and study area are compared in Figure A-5-13.

A.5.244. Table A-5-22 provides, by parish, a tabulation of the study area civilian labor force in 1970 and includes a greater proportion of blue-collar and farm workers (43.6 percent) in comparison to the statewide average for such employment (37.2 percent). Among the experienced unemployed in 1970, again the study area civilian labor force included a higher proportion of blue-collar and farm workers (3.3 percent) relative to the state (2.7 percent).

EDUCATION

A.5.245. In 1970 the median number of school years completed among persons 25 years and over averaged 12.2 years nationally while the comparable Louisiana figure was 10.8 years. Except for Ouachita Parish (Monroe area), all parishes within the study area were below the state in median number of school years completed among persons 25 years and over. Such information for the US, state, and study area by sex is shown in Table A-5-23.



SOURCE: U.S. DEPT. OF COMMERCE, BUREAU OF CENSUS, "GENERAL SOCIAL AND ECONOMIC CHARACTERISTICS, LOUISIANA, 1970."

FIGURE A-5-13 AREAS OF EMPLOYMENT

TABLE A-5-22

CIVILIAN LABOR FORCE CHARACTERISTICS (1970)

	Civilian Labor Force			Employed[1]					Experienced Unemployed[2]				
Parish	Total	Male	Female	Total	White Collar	Blue Collar	Farm Workers	Service Workers	Total	White Collar	Blue Collar	Farm Workers	Service Workers
Assumption	5,291	4,051	1,240	4,929	1,172	2,409	720	628	347	37	197	78	20
Avoyelles	10,806	7,568	3,238	9,859	3,774	3,067	1,348	1,670	846	103	518	107	108
Caldwell	2,849	1,913	936	2,700	851	979	273	597	132	13	76	12	31
Catahoula	3,278	2,271	1,007	3,091	941	1,184	463	503	164	16	99	14	35
Concordia	7,276	4,684	2,592	6,807	2,603	2,490	606	1,108	426	70	209	37	95
Franklin	6,792	4,405	2,387	6,319	2,154	2,053	1,261	851	423	48	201	80	94
Iberia	18,456	12,638	5,818	17,346	6,374	7,248	914	2,810	939	185	485	61	193
Iberville	8,863	5,936	2,927	8,018	2,558	3,341	475	1,644	730	88	478	27	120
Lafourche	21,900	16,347	5,553	20,964	7,880	9,538	758	2,788	855	97	510	47	144
LaSalle	4,080	2,909	1,171	3,810	1,252	2,013	35	510	239	34	150	0	35
Ouachita	41,595	25,371	16,224	39,340	19,398	12,993	478	6,471	2,005	622	961	15	379
Pointe Coupee	6,084	4,270	1,814	5,510	1,729	2,151	798	832	491	85	276	25	101
Richland	6,225	3,995	2,230	5,849	1,888	2,113	985	863	346	56	175	66	46
St. Landry	22,120	15,366	6,754	20,569	7,146	7,907	2,094	3,422	1,334	159	823	97	250
St. Martin	8,971	6,336	2,635	8,301	2,495	3,596	823	1,387	626	68	449	45	57
St. Mary	20,094	14,050	6,044	19,130	7,818	8,016	725	2,571	846	215	374	88	143
Tensas	2,525	1,708	817	2,388	653	580	663	492	133	7	47	49	30
Terrebonne	23,737	17,348	6,389	22,958	9,219	10,505	458	2,776	731	168	437	10	112
West Baton Rouge	4,982	3,437	1,545	4,583	1,524	2,134	257	668	332	71	163	33	65
TOTAL	225,924	154,603	71,321	212,471	81,429	84,317	14,134	32,591	11,945	2,142	6,628	891	2,058
% of Civilian Labor Force	100.0	68.4	31.0	94.0	36.0	37.3	6.3	14.4	5.3	0.9	2.9	0.4	0.9
LOUISIANA	1,224,186	788,384	435,802	1,158,245	523,887	418,293	37,144	178,291	59,089	14,496	30,022	1,938	11,316
% of Civilian Labor Force	100.0	64.4	35.6	94.6	42.8	34.2	3.0	14.6	4.8	1.2	2.5	0.2	0.9

[1] White Collar - professional, technical, and kindred workers; managers and administrators, except farm; sales workers; and clerical and kindreds.
Blue Collar - craftsmen and kindred workers; operatives, except transport; transport equipment operatives; and laborers, except farm.
Farm Workers - farmers and farm managers; farm laborers and farm foreman.
Service Workers - service workers including private households.
[2] Includes persons who last worked more than 10 years ago, not shown separately.

Source: US Department of Commerce, Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

TABLE A-5-23

EDUCATIONAL CHARACTERISTICS

Area	Persons 25 Years and Over Median School Years Completed		
	Males	Females	Total
Assumption	7.2	7.9	7.5
Avoyelles	8.3	8.9	8.6
Caldwell	8.7	10.4	9.7
Catahoula	8.8	9.8	9.3
Concordia	9.6	10.2	9.9
Franklin	8.4	9.3	8.9
Iberia	9.1	9.5	9.4
Iberville	8.5	8.9	8.7
Lafourche	8.4	8.6	8.5
LaSalle	9.6	10.7	10.2
Ouachita	11.7	11.7	11.7
Pointe Coupee	8.0	8.4	8.2
Richland	8.6	9.2	8.9
St. Landry	7.6	8.1	7.8
St. Martin	6.9	7.9	7.5
St. Mary	9.8	10.0	9.9
Tensas	7.7	8.1	7.9
Terrebonne	9.2	9.8	9.6
West Baton Rouge	10.1	10.1	10.1
LOUISIANA	10.7	10.8	10.8
UNITED STATES	12.2	12.2	12.2

Source: U.S. Department of Commerce, Bureau of the Census, "Statistical Abstract of the U.S., 1976."

U.S. Department of Commerce, Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

Development and Economy

A.5.246. The general area of direct economic impact includes the gently rolling terrain north of the floodway system, the floodway system and adjacent alluvial ridges, and the coastal marshes to the south. The economic area comprises approximately 9.1 million acres, or 29 percent of the state's total area, and contains about 36 percent of statewide marshlands.

A.5.247. More than 30 percent of the state lands devoted to agricultural use lie within the economic area. This large percentage has been achieved by intensive utilization of the alluvial ridge lands lying along the rivers and bayous, and reclamation of sizable swamp and marsh areas.

A.5.248. The percentage of urban land and transportation network development throughout the economic area is disproportionately low relative to that of the state. This is primarily attributable to the large acreage low-lying areas in the coastal region that are of limited utility for these purposes.

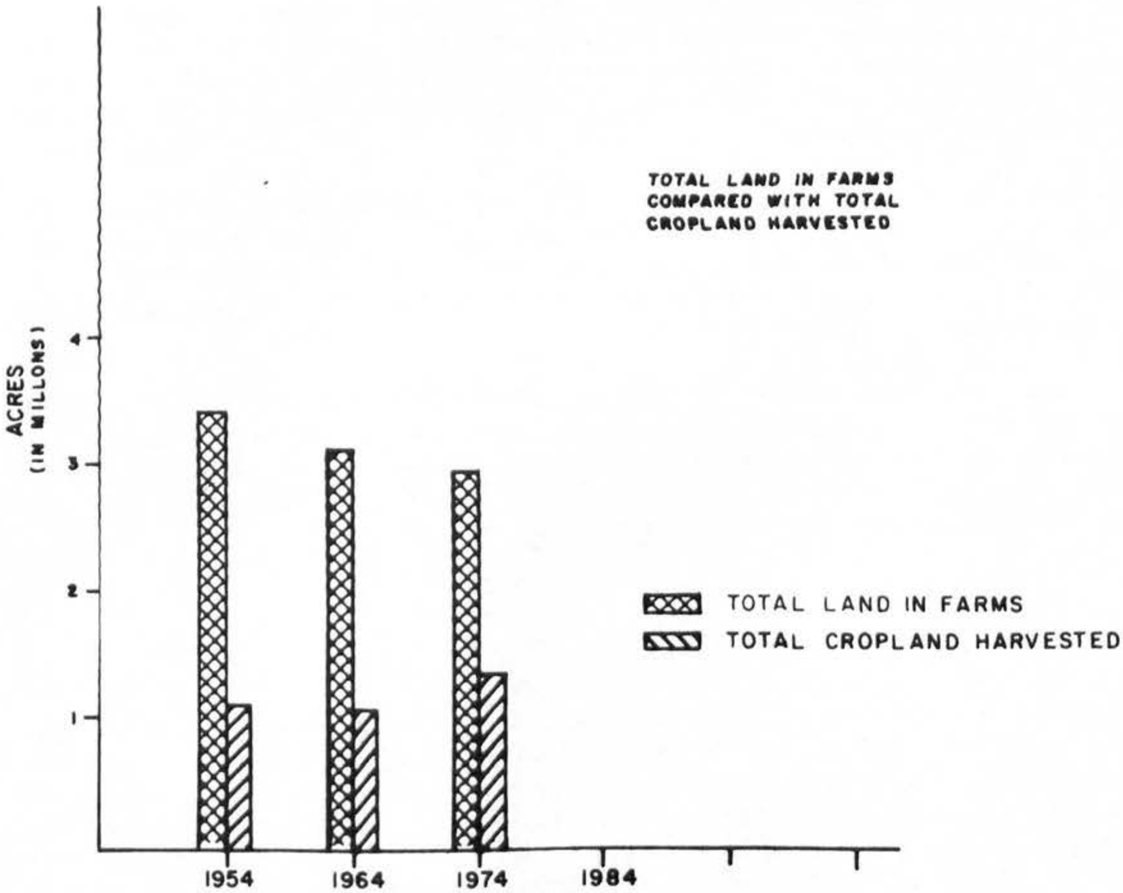
RURAL AND AGRICULTURAL DEVELOPMENT

A.5.249. Agricultural activity within the economic area, the importance of which is indicated in the aforementioned land-use description, is related almost solely to crop production, primarily soybeans, sugarcane, cotton, hay, and corn, in order of harvested acreages. About 3 million acres are in farms (Table A-5-24), almost half of which is comprised of harvested cropland. The value of all farm products sold in 1974, shown in Table A-5-25, was $456.7 million, with $421.9 million of this amount, or 92 percent, attributable to crop sales. The 1964-74 period was characterized by increased emphasis on crop production within the economic area, accounting for a sizable portion of the increase.

A.5.250. While total land in farms decreased from 1954 to 1974, total cropland harvested increased during the same period (Figure A-5-14).

URBAN DEVELOPMENT

A.5.251. There are no major urban areas in the Atchafalaya Basin Floodway System, although the Morgan City-Berwick-Patterson complex of cities, sits astride the southern end of the Lower Atchafalaya Basin Floodway. These cities are the focal point for the industrial, marine, and energy firms engaged in offshore exploration and production of oil and gas resources in the Louisiana gulf region. Other urban centers located in the backwater area parishes northeast of



SOURCE: U.S. DEPT. OF COMMERCE, BUREAU OF CENSUS, "CENSUS OF AGRICULTURE, LOUISIANA" 1974, 1969, 1959.

FIGURE A-5-14 AGRICULTURAL LAND

TABLE A-5-24

AGRICULTURAL LAND
(In Acres)

Parish	Total Land in Farms			Total Cropland Harvested		
	1954	1964	1974	1954	1964	1974
Assumption	88,315	87,775	79,789	45,751	41,150	40,572
Avoyelles	223,996	233,265	252,410	84,100	86,426	138,291
Caldwell	81,216	73,440	58,350	17,933	18,216	20,769
Catahoula	134,375	132,065	203,925	37,714	41,804	121,119
Concordia	223,481	279,795	216,788	35,552	58,494	109,552
Franklin	329,650	305,645	296,567	119,161	129,995	172,229
Iberia	133,410	133,985	115,230	65,343	58,413	54,692
Iberville	134,561	123,265	116,201	36,814	32,371	38,794
Lafourche	230,790	225,015	215,099	57,360	50,798	44,385
LaSalle	35,274	28,357	17,739	3,243	2,329	2,736
Ouachita	175,069	127,935	91,540	35,454	35,985	35,796
Pointe Coupee	240,730	221,155	194,516	54,290	51,551	61,527
Richland	268,407	248,175	273,687	104,110	104,445	146,088
St. Landry	328,024	330,015	302,484	155,267	131,035	168,723
St. Martin	130,097	108,365	92,403	70,019	48,607	38,471
St. Mary	162,162	123,285	115,581	54,782	48,543	50,267
Tensas	250,373	218,435	229,441	65,640	65,044	114,502
Terrebonne	116,627	123,415	62,297	26,821	27,480	21,957
West Baton Rouge	55,198	47,536	38,728	20,899	16,928	18,260
STUDY AREA	3,341,755	3,170,923	2,972,775	1,090,253	1,049,614	1,398,730
Percent of State	29.2	32.4	32.6	36.2	39.3	39.5
LOUISIANA	11,441,343	9,788,662	9,111,853	3,010,580	2,672,650	3,541,074

Source: US Department of Commerce, Bureau of the Census, "Census of Agriculture, Louisiana, 1974, 1969, 1959."

TABLE A-5-25

VALUES OF AGRICULTURAL PRODUCTION
(In Thousands of Dollars)

Parish	Value of All Agricultural Products Sold			Value of All Crops Sold			Value of All Livestock, Poultry and Related Products Sold		
	1954	1964	1974	1954	1964	1974	1954	1964	1974
Assumption	$ 5,364	$ 6,617	$ 37,831	$ 5,226	$ 6,423	$ 37,689	$ 138	$ 182	$ 142
Avoyelles	8,987	9,331	32,360	7,475	7,051	29,055	1,511	2,254	3,283
Caldwell	1,749	2,548	4,328	1,433	2,124	3,425	316	394	822
Catahoula	3,150	4,604	20,961	2,548	3,743	19,428	601	833	1,507
Concordia	3,413	5,584	19,677	2,643	4,015	18,226	771	1,501	1,348
Franklin	8,862	15,459	29,239	7,323	13,212	25,820	1,539	2,179	3,348
Iberia	6,086	8,809	43,954	5,088	6,966	41,583	1,047	1,804	2,371
Iberville	3,702	4,482	25,366	3,040	3,790	24,474	661	664	870
Lafourche	5,329	7,156	35,426	4,897	6,708	34,206	432	448	1,189
LaSalle	328	491	901	96	137	248	232	333	646
Ouachita	4,022	5,939	7,819	3,024	4,320	5,468	998	1,540	2,336
Pointe Coupee	5,390	5,748	18,300	4,150	3,686	15,575	1,240	1,989	2,707
Richland	7,571	12,444	26,447	6,539	10,556	21,365	1,032	1,864	4,991
St. Landry	16,772	14,292	38,240	14,967	11,383	33,268	1,805	2,854	4,875
St. Martin	6,095	5,457	18,877	5,477	4,404	17,840	618	1,045	1,036
St. Mary	4,600	6,432	44,552	4,473	6,333	44,508	126	93	44
Tensas	7,264	7,269	23,835	6,035	6,137	21,717	1,229	1,049	2,075
Terrebonne	2,785	3,434	14,226	2,449	3,167	14,017	336	266	203
West Baton Rouge	2,216	2,432	14,411	1,930	2,023	13,954	286	408	457
STUDY AREA	$103,685	$128,528	$ 456,750	$ 88,763	$106,178	$421,866	$14,918	$ 21,700	$ 34,255
Percent of State	33.5	31.6	39.0	36.7	38.1	46.3	22.0	17.5	13.5
LOUISIANA	$309,791	$406,795	$1,170,846	$241,941	$278,915	$910,477	$67,850	$124,005	$254,340

Source: US Department of Commerce, Bureau of the Census, "Census of Agriculture, Louisiana, 1959, 1969, 1974."

Morgan City are Houma in Terrebonne Parish, and Thibodaux in Lafourche Parish. Urban centers not in the actual floodways but in floodway parishes are New Iberia in Iberia Parish, and Opelousas and Eunice in St. Landry Parish. The urban centers of Monroe and West Monroe are located in the Red River backwater parish of Ouachita.

EMPLOYMENT AND INCOME

A.5 252. The study area has consistently ranked lower than Louisiana in per capita personal income since 1950. As shown in Table A-5-26, in 1974 there were only two study area parishes, Richland and St. Mary, with per capita personal income levels exceeding the comparable state figure of $4,392. Crop production, primarily rice, contributes much of the personal income earned in Richland Parish, while mining, trade, manufacturing, transportation, and services employment contribute heavily to personal income earned in St. Mary Parish.

A.5.253. The study area civilian labor force numbered 225,924 in 1970 (Table A-5-27). The unemployment rate of the study area in 1970, 6 percent, was slightly higher than the comparable statewide figure of 5.4 percent. Avoyelles Parish experienced the highest unemployment rate within the study area, 9.4 percent, while Terrebonne Parish was lowest with a rate of 3.3 percent in 1970. According to data from the Louisiana Department of Employment Security, the study area unemployment rate was approximately 6.3 percent in 1976, which was lower than the comparable statewide figure of 6.8 percent.

TRANSPORTATION

A.5.254. The area abounds with navigable waterways. The Atchafalaya River and associated channels provide a water route extending the length of the floodway system while the deepwater channel of the Misssissippi River lies just east of the area. The shallow-draft GIWW traverses the entire coast, intercepting numerous rivers and bayous and crossing many bays and lakes. Included in this waterway system is an alternate route of the GIWW, which extends some 64 miles from Morgan City to Port Allen, Louisiana. This vital link for the towboat industry provides a shorter and faster route from the Morgan City area to and from the barge-fleeting areas on the Mississippi River. Other natural and manmade channels provide water access to practically all sections of the economic area.

A.5.255. Major offshore large-diameter pipelines, about equally devoted to the transport of natural gas and crude petroleum, supply shore-based terminals that, in turn, supply intrastate and interstate markets with these raw materials. Many miles of small-diameter

TABLE A-5-26

PER CAPITA INCOME
(IN DOLLARS)

Parish	1950	1959	1970	1974
Assumption	$ 736	$1,237	$2 255	$3,770
Avoyelles	663	964	2,130	3,177
Caldwell	813	984	2,145	2 889
Catahoula	694	846	2,269	3,702
Concordia	864	1,271	2,431	4,047
Franklin	692	902	2,220	3,754
Iberia	934	1,390	2,628	3,910
Iberville	690	1,150	2,667	3,981
Lafourche	810	1,484	2,674	4,114
La Salle	945	1,299	2,363	3,465
Ouachita	1,210	1,652	2,860	4,044
Pointe Coupee	604	827	2,296	3,518
Richland	671	909	2.549	4,561
St. Landry	635	905	2,040	3,123
St. Martin	623	713	1,868	2,924
St. Mary	818	1,479	3,020	4,510
Tensas	551	1,029	2,297	4,309
Terrebonne	782	1,442	2,866	4,238
West Baton Rouge	668	1,077	2,556	3,827
TOTAL	$ 792	$1,233	$2,545	$3,852
LOUISIANA	$1,094	$1,369	$3,090	$4,392

Source: US Department of Commerce, Bureau of Economic Analysis, "Per Capita Personal Income, SMSA's Counties and Parishes - Lower Mississippi Region and Adjacent States, 1929-1970;" and US Department of Commerce, Bureau of Economic Analysis, "Local Area Personal Income 1969-1974." Volume 3: Southeastern States.

TABLE A-5-27

EMPLOYMENT DATA (1970)

Parish	Civilian Labor Force	Total Unemployed Number	Total Unemployed Rate	Total Employed	Agriculture, Forestry, & Fisheries	Mining	Construction	Manufacturing	Transportation, communications & Utilities	Trade	Finance, Insurance & Real Estate	Services	Government
Assumption	5,291	362	6.8	4,929	937	219	569	1,081	254	670	67	671	461
Avoyelles	10.806	947	8.8	9,859	1,435	241	1,361	877	552	1,916	348	2,055	1,074
Caldwell	2,849	149	5.2	2,700	351	111	283	362	116	431	85	668	293
Catahoula	3,278	187	5.7	3,091	596	188	306	371	160	474	37	590	369
Concordia	7,276	469	6.4	6.807	701	540	505	1,057	492	1,374	168	1,336	684
Franklin	6,792	473	7.0	6,319	1,360	167	518	665	298	1,312	180	1,098	721
Iberia	18,456	1,110	6.0	17,346	1,090	2,673	1,076	2,242	1,073	3,894	486	3,531	1,281
Iberville	8,863	845	9.5	8,018	548	363	1,088	1,361	534	1,297	236	1,820	771
Lafourche	21,900	936	4.3	20,964	1,362	2,191	1,789	3,193	2,045	4,343	512	3,305	2,134
LaSalle	4,080	270	6.6	3,810	84	606	253	907	279	652	61	676	292
Ouachita	41,595	2,255	5.4	39,340	692	402	3,083	6,069	1,663	10,900	2,301	9,771	4,430
Pointe Coupee	6,084	574	9.4	5,510	844	66	913	707	193	1,011	101	1,071	604
Richland	6,225	376	6.0	5,849	1,037	166	558	786	177	1,359	165	980	621
St. Landry	22,120	1,551	7.0	20,569	2,362	1,335	2,901	1,337	1,278	4,478	541	4,158	2,179
St. Martin	8,971	670	7.5	8,301	991	696	1,316	717	488	1,581	191	1,564	757
St. Mary	20,094	964	4.8	19,130	1,120	2,347	1,491	2,647	2,162	3,878	620	3,520	1,045
Tensas	2.525	137	5.4	2,388	707	62	103	181	105	393	52	539	266
Terrebonne	23,737	779	3.3	22,958	1,036	4.255	1,465	2,698	2,480	4,850	687	3,817	1,670
West Baton Rouge	4,982	399	8.0	4,583	309	68	617	1,070	383	774	135	799	423
TOTAL	225,924	13,453	---	212,471	17,562	16,696	20,195	28,328	14,732	45,577	6,973	42,109	20,299
Percent of Civilian Labor Force	100.0	6.0	---	94.0	7.8	7.4	8.9	12.5	6.5	20.2	3.1	18.6	9.0
LOUISIANA	1,224,186	65,941		1,158,245	47,999	46,584	96,609	184,024	95,487	245,661	51,250	263,216	127,415
Percent of Civilian Labor Force	100.0	5.4	---	94.6	3.9	3.8	7.9	15.0	7.8	20.1	4.2	21.5	10.4

Source: US Department of Commerce, Bureau of the Census, "General Social and Economic Characteristics, Louisiana, 1970."

pipelines connect producing natural gas and crude oil wells with collection facilities for transport to processing and refining plants.

A.5.256. Extensive railroad facilities in the area include routes of the Missouri Pacific, Southern Pacific, Texas and Pacific, and the Kansas City Southern Lines. The Missouri Pacific routes are generally located in the northern portion of the study area and include a connection between the towns of Monroe and Alexandria. One line of the Missouri Pacific is located in the southern portion of the economic area in an east-west direction between Baton Rouge and Opelousas. The Southern Pacific Line skirts the westernmost edge of the study area, connecting Alexandria, Opelousas, Lafayette, New Iberia, Franklin, and Patterson. The route turns eastward through the coastal region, extending through Morgan City and Thibodaux, then to New Orleans. Texas and Pacific, and Kansas City Southern Lines lie in close parallel with the eastern boundary of the study area from Alexandria to the vicinity of Baton Rouge, proceeding along both banks of the Mississippi River to New Orleans.

A.5.257. Also, trucking operations supply the population and serve industry and trade. At least 20 motor freight lines provide facilities in the area. Service is available between cities within the economic area and to and from centers outside the area.

A.5.258. Airport facilities are available in Houma, Monroe, and Morgan City. Numerous smaller airfields and landing strips as well as heliports and seaplane bases are scattered throughout the area. Within commuting distance to the area are the New Orleans International, Baton Rouge, Alexandria, and Lafayette airports.

A.5.259. I-10 crosses the basin in an east-west direction between Baton Rouge and Lafayette. US Highways 90 and 190 also traverse the area in an east-west direction. US Highway 90 connects the major urban coastal centers, including Houma, Morgan City, Franklin, New Iberia, and Lafayette. US Highway 190 crosses the central portion of the area between Baton Rouge and Opelousas.

A.5.260. North-south Federal highways include 71, 165, and 167. US Highway 71 begins at Krotz Springs at about midpoint in the economic area and runs in a northwesterly direction through Alexandria. US Highway 165 connects the towns of Alexandria and Monroe; US Highway 167 runs between Lafayette, Opelousas, and Alexandria, and connects US Highways 90 and 190 and I-10. LA Highway 1 roughly parallels the eastern boundary of the basin study area from Alexandria southeast through Thibodaux to the coast. LA Highway 105 connects US Highway 190 and LA Highway 1 between Krotz Springs and Simmesport. Numerous local roads exist in the economic area, as parish highways follow north-south routes paralleling the Atchafalaya Floodway System or run on top of the floodway protection levees. In the floodway proper, between I-10 and US Highway 90, there are no roadways.

OIL, GAS, AND MINERALS

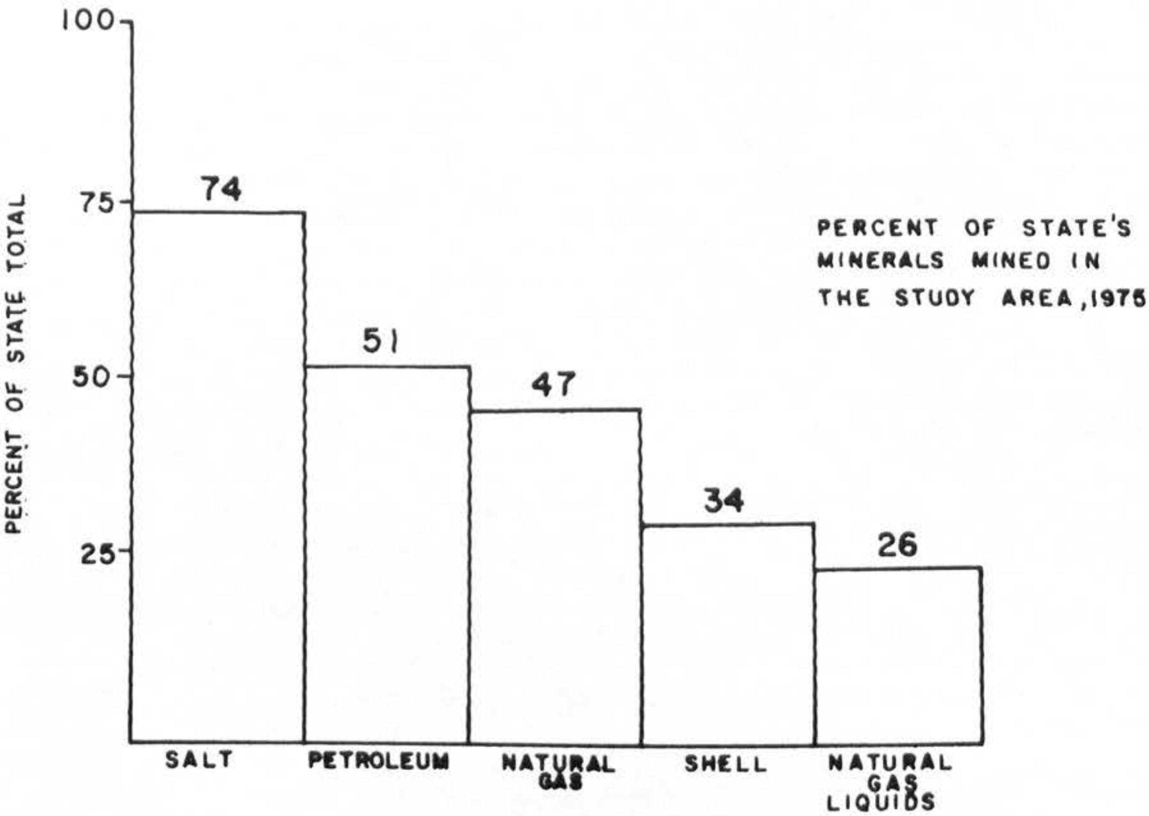
A.5.261. Many factors have led to an increasing demand for the area's mineral resources: the transition of the nation's economy from largely agrarian to highly industrial; the many technical advancements made since the turn of the century and resulting mass production of new products, the revolutionary changes in transportation systems, and the expansion of markets. Minerals produced in the 19-parish economic area include petroleum, natural gas, natural gas liquids, salt, sulfur, sand and gravel, shell, clay, and lime. By-products of the natural gas and shell include carbon black and cement. Petroleum production in Louisiana increased from 104 million barrels in 1940 to 209 million in 1950, to 401 million barrels in 1960 and 907 million in 1970. Its value increased from $107 million in 1940 to $3,062 million in 1970. The "Bureau of Mines Minerals Yearbook for 1976" reports crude petroleum production in Louisiana to have been 607 million barrels valued at $4,557 million.

A.5.262. Natural gas production in the state increased from 343 thousand million cubic feet (MMCF) valued at $64 million in 1940 to 7,007 MMCF valued at $3,223 million in 1976. Oil and gas account for almost 90 percent of the value of the state's mineral production. Table A-5-28 shows the value of production in the economic area for randomly selected years from 1960 to 1970 and for the 6 subsequent years of record. The table also compares data for the economic area with data for the state and nation.

A.5.263. The percentage of the state's minerals that come from the study area is shown by Figure A-5-15. In 1976, the value of mineral production in the area's four coastal parishes alone totaled $3.4 billion or 4.9 percent of the US total. Table A-5-29, shows a further disaggregation of values and the quantities of major minerals and associated raw materials produced in the area.

A.5.264. More than any other single factor, the expansion of mineral production has led to the area's employment, income, and population growth. Only six of Louisiana's 64 parishes have unemployment levels below 6 percent. Five of them are in South Louisiana and three of the five (Iberia, Lafourche, and Terrebonne) are coastal parishes of the Atchafalaya economic area. The 1970 census reported that direct employment in mineral production accounted for 14 percent of the total in coastal parishes and 8 percent in the economic area overall.

A.5.265. In comparison, employment in agriculture, forestry, and fisheries combined also accounted for about 8 percent. From 1949 to 1959 the number of parishes in the area with median family incomes exceeding the state median increased from 1 to 5. Per capita personal income increased from 72 percent of the state figure in 1950 to 90 percent in 1959. Since the late 1950's and early 60's some of the



SOURCE: U.S. DEPT. OF THE INTERIOR, BUREAU OF MINES, "THE MINERAL INDUSTRY OF LOUISIANA 1975", AND UNPUBLISHED DATA.

FIGURE A-5-15 MINERALS

TABLE A-5-28
VALUE OF MINERAL PRODUCTION - ATCHAFALAYA BASIN AREA
(In Thousands)

Area	1960	1965	1969	1970	1971	1972	1973	1974	1975	1976
Assumption	$ 20,165	$ 19,941	$ 28,800	$ 29,651	$ 29,847	$ 30,284	$ 33,245	$ 44,260	$ 51,909	$ 60,032
Avoyelles	1,914	3,660	5,732	4,420	5,810	4,112	3,374	5,536	5,333	5,297
Caldwell	583	2,561	2,516	3,088	3,946	3,345	2,626	1/	1/	1/
Catahoula	5,419	10,377	9,526	10,949	11,309	10,943	8,313	15,640	1/	14,772
Concordia	14,948	18,972	29,216	23,894	1/	21,521	16,379	23,321	22,978	22,964
Franklin	2,627	1,978	2,185	2,108	2,397	2,219	2,278	2,361	2,318	2,309
Iberia	84,715	92,225	235,463	216,385	298,230	311,490	329,511	432,670	469,761	495,556
Iberville	26,992	44,194	60,166	61,881	67,260	61,775	59,521	73,077	70,084	68,397
Lafourche	187,319	309,069	474,939	515,299	470,507	426,523	439,940	582,091	583,386	583,167
LaSalle	17,584	18,532	21,970	25,075	23,840	23,199	22,774	34,770	33,821	33,700
Ouachita	9,423	9,417	20,961	6,461	1/	7,054	7,273	11,146	1/	15,287
Pointe Coupee	7,752	11,422	30,378	31,162	29,427	24,339	22,306	33,706	33,210	32,458
Richland	16,515	15,070	16,819	18,484	22,518	24,597	29,953	47,631	45,968	45,636
St. Landry	40,699	47,433	50,965	48,283	42,582	37,324	43,311	52,705	50,806	51,783
St. Martin	48,468	64,502	89,122	88,187	89,672	79,961	69,312	95,802	97,852	101,246
St. Mary	122,644	234,936	390,233	473,513	536,844	524,946	633,573	961,699	1,016,590	1,045,633
Tensas	15,010	17,405	7,554	8,463	4,202	3,646	3,350	4,712	4,890	5,017
Terrebonne	199,815	366,583	626,619	756,968	874,853	852,821	901,082	1,196,121	1,265,588	1,268,862
West Baton Rouge	1,103	652	4,382	2,603	1/	1/	6,426	8,556	8,117	8,035
TOTAL	$823,695	$1,288,929	$2,107,546	$2,326,874	$(2,513,244)	$(2,450,099)	$2,634,547	$(3,625,804)	($3,762,611)	($3,860,151)
Percent of State Total	41.4	43.1	45.0	45.6	45.3	45.3	45.3	44.5	44.2	44.6
US Total (millions)	$18,032	$21,524	$26,791	$29,791	$30,708	$32,217	$36,788	$55,172	$62,266	$69,178
* Percent of US Total	4.6	6.0	7.8	7.8	8.2	7.6	7.2	6.6	6.0	5.6

1/ - Withheld to avoid disclosure of confidential data of individual companies.

Sources: US Department of Interior, Bureau of Mines, "Bureau of Mines Mineral Yearbook" (preprints) for Louisiana "The Mineral Industry of Louisiana."
* US Department of Commerce, Bureau of the Census, "Statistical Abstract of the United States".

TABLE A-5-29
VALUE AND QUANTITY OF MAJOR MINERALS IN STUDY AREA

	SALT		STONE (SHELL)		PETROLEUM		NATURAL GAS LIQUIDS		NATURAL GAS	
	$1,000 Value	(Thousand, short ton) Product	$1,000 Value	(Thousand, short ton) Product 1/	$1,000 Value	Product 2/	$1,000 Value	Product 2/	$1,000 Value	MMCF Product
1970	55,453	10,740	6,139	4,285	1,455,537	431,165	95,708	41,879	692,410	3,603,122
1971	58,449	10,335	6,335	4,474	1,586,129	441,529	107,808	42,975	783,014	3,876,314
1972	57,342	10,451	5,703	4,483	1,480,597	412,422	108,621	42,762	785,573	3,850,846
1973	54,772	9,811	7,522	5,188	1,546,541	386,448	126,853	42,527	885,768	3,954,316
1974	64,232	10,278	7,198	4,369	2,227,945	341,395	183,678	39,396	1,126,094	3,718,173
1975	64,140	8,952	12,363	3,528	2,135,356	334,077	148,961	34,907	1,415,232	3,345,887
1976	75,582	10,967	3/	3/	2,110,028	280,845	118,747	26,192	1,522,033	3,304,906

1/ Production of clays 1970-77 3,691,000 short tons, value $5,511,000.
Production of sand and gravel 1970-76, 10,139,000 short tons, value $18,102,000.
Information on the value and production of carbon black, lime, and sulphur was withheld so as not to reveal individual company data.
2/ Measured in thousand 42-gallon barrels.
3/ - Withheld so as not to disclose individual company data.

Source: US Department of the Interior, Bureau of Mines, unpublished data.

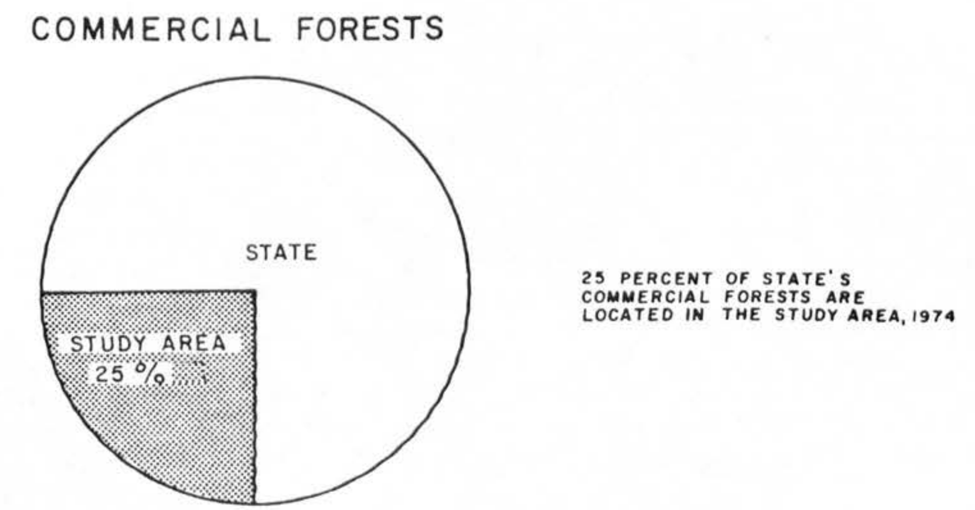
construction associated with mineral production has declined; nevertheless, the 1970 Census indicated that the three parishes producing the greatest quantities of oil and gas (Lafourche, St. Mary, and Terrebonne) also were the three parishes with median family incomes exceeding the state's median family income.

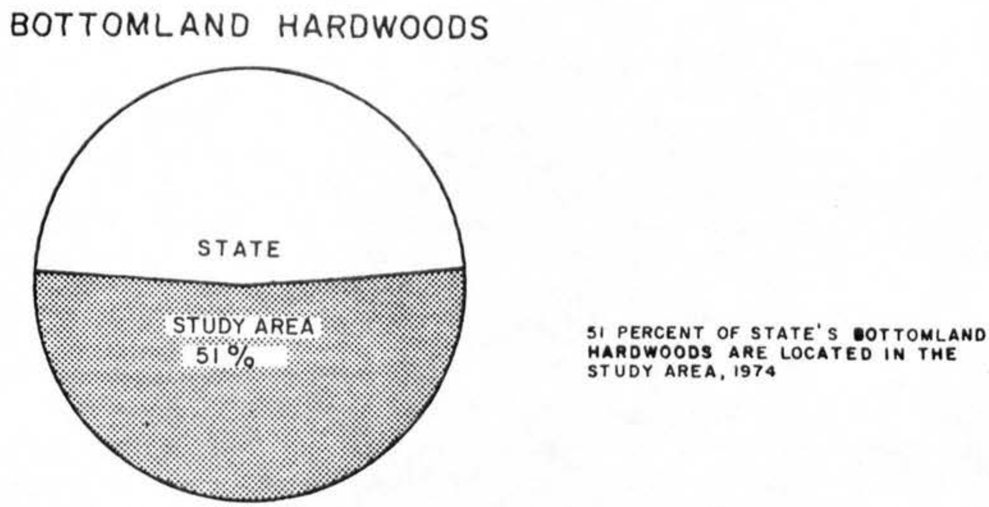
A.5.266. The impacts of expanded mineral production and associated economic growth since the 1950's can be further illustrated by population trends in the coastal parishes. From 1950 to 1960, the population of the area's coastal parishes increased at an annual compound rate of 2.7 percent while the population of the US increased at an annual rate of 1.7 percent. From 1960 to 1970, the population of these parishes increased at an annual rate of 1.9 percent while population increased nationally at a rate of 1.3 percent annually.

TIMBER

A.5.267. Commercial forests comprise a large portion of the study area, almost 40 percent. In fact, 25 percent of the state's commercial forests are located in the study area. Also 51 percent of the bottomland hardwoods in the state are in this area (Figure A-5-16). Although this area abounds in trees, commercial forests are decreasing faster than the state average. During the period 1964-74, commercial forests in the study area decreased 15.7 percent compared with a 9-percent decrease in the state (Table A-5-30). Sixteen of the 19 parishes in the study area had decreases in commercial forest area from 1964 to 1974.

A.5.268. The total stumpage value of severed timber within the study area amounts to only a small portion of the state's total timber value due to the high value and volume of pine produced in other areas. However, the study area accounts for a large portion of the state's hardwoods. Over 70 percent of the cypress and 41 percent of the cottonwood and willow severed in the state come from the study area (Table A-5-31). This area accounted for 35 percent of all hardwood timber severed in the state in 1977 (Figure A-5-17). In 1976 the total stumpage value of severed timber in the economic area was about \$13.5 million, or 11.2 percent of the state total, with about 69 percent of this income ascribable to the severence of pine and pulpwood pine (Table A-5-32). About two-thirds of the total study area timber sales occurred in the northern study area parishes of Caldwell, LaSalle, and Ouachita.





SOURCE: U.S. DEPT. OF AGRICULTURE, "FOREST STATISTICS FOR LOUISIANA PARISHES, 1975."

FIGURE A-5-16 COMMERCIAL FOREST AREAS

TABLE A-5-30

FORESTRY DATA
(In Thousands of Acres)

Parish	Total Area	Commercial Forest Area	Percentage Change 1964-74	Bottomland Hardwoods
Assumption	243.2	138.6	-3%	138.6
Avoyelles	544.0	239.4	-24%	222.3
Caldwell	352.6	284.2	-7%	98.6
Catahoula	480.6	203.0	-41%	119.0
Concordia	480.0	219.3	-30%	219.3
Franklin	414.7	67.1	-53%	54.9
Iberia	414.1	121.9	+6%	121.9
Iberville	411.5	279.3	-1%	279.3
Lafourche	865.9	178.2	+14%	178.2
LaSalle	427.5	357.5	-4%	110.0
Ouachita	411.5	256.2	-15%	109.8
Pointe Coupee	376.3	154.0	-21%	154.0
Richland	369.3	86.9	-42%	86.9
St. Landry	598.4	220.0	-14%	214.5
St. Martin	514.6	305.5	-2%	299.0
St. Mary	453.8	148.5	+4%	148.5
Tensas	413.4	162.0	-30%	162.0
Terrebonne	1,114.3	113.4	-7%	113.4
West Baton Rouge	135.7	62.0	-10%	62.0
Total	9,050.8	3,597.0	-15.7%	2,892.2
State Total	31,059.4	14,526.6	-9%	5,635.5
% of State Total	29.1%	24.8%		51.3%

Source: US Department of Agriculture, "Forest Statistics for Louisiana Parishes, 1975."

TABLE A-5-31

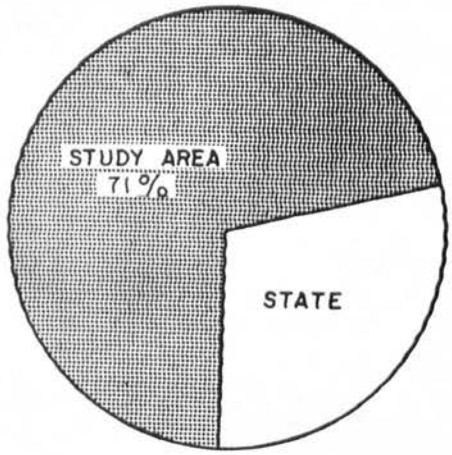
TIMBER SEVERED BY SPECIES AND PARISH (1977)
Board Feet - Doyle Scale

Parish	Hardwood[1/]	Pulpwood Hardwood[2/]	Cypress	Cottonwood and Willow
Assumption	232,309	112.72	12,256	3,040
Avoyelles	3,446,060	16,493.82	152,125	66,204
Caldwell	3,647,201	19,967.23	2,795	27,783
Catahoula	3,078,664	22,449.49	73,390	16,288
Concordia	14,440,334	51,257.46	276,873	788,767
Franklin	1,313,131	3,281.05	15,770	10,196
Iberia	0	61.88	0	0
Iberville	4,380,652	308.23	314,301	703,879
Lafourche	1,095,284	0	426,832	3,947
LaSalle	2,881,267	21,597.83	17,046	416
Ouachita	3,604,113	26,357.40	78,056	338
Pointe Coupee	6,673,557	18,249.59	159,616	296,758
Richland	3,798,477	4,208.31	184,833	7,184
St. Landry	10,095,817	8,243.84	347,139	444,835
St. Martin	204,179	723.12	29,034	189,452
St. Mary	497,338	15.65	0	0
Tensas	15,494,284	61,194.01	321,402	2,149,393
Terrebonne	244,500	0	422,845	0
West Baton Rouge	2,494,415	582.88	22,419	211,223
Total	77,621,582	255,104.51	2,856,732	4,919,703
State Total	221,553,804	731,686.94	4,031,298	12,006,080
Percent of State	35	34.9	70.9	41

1/ Includes oak, ash, gum, and other hardwoods not including cypress, cottonwood, and willow.
2/ Measured in standard cords.

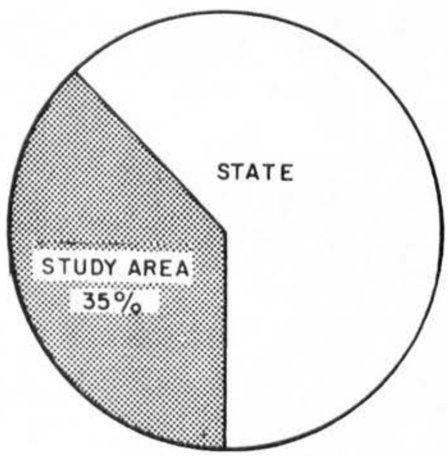
Source: Louisiana Department of Natural Resources, Office of Forestry, "Timber and Pulpwood Production in Louisiana", April 1978.

CYPRESS



71 PERCENT OF CYPRESS TIMBER SEVERED IN THE STATE IS IN STUDY AREA, 1977

HARDWOODS



35 PERCENT OF HARDWOOD TIMBER SEVERED IN THE STATE COMES FROM STUDY AREA, 1977

SOURCE: LOUISIANA DEPT. OF NATURAL RESOURCES, OFFICE OF FORESTRY "TIMBER AND PULPWOOD PRODUCTION IN LOUISIANA", APRIL 1978.

FIGURE A-5-17 CYPRESS AND HARDWOODS

TABLE A-5-32

1976 FORESTRY DATA
(In Dollars)

Parish	Stumpage Value of Severed Timber							
	Total	Cypress	Oak	Ash	Pine	Pine Pulpwood	Gum	Cotton & Willow
Assumption	2,425	8	1,128	3	---	466	667	---
Avoyelles	337,909	6,171	110,483	17,064	22,641	26,790	36,134	7,325
Caldwell	2,820,713	1,252	104,184	251	2,396,960	195,969	17,971	79
Catahoula	996,747	2,281	72,612	19,798	540,868	80,413	29,846	1,232
Concordia	431,945	3,242	114,322	18,126	---	670	27,245	10,002
Franklin	172,126	670	21,718	996	135,382	3,488	1,864	50
Iberia	1,171	---	---	---	---	---	---	---
Iberville	462,084	37,514	71,258	99,256	1,526	56	45,759	89,125
Lafourche	95,184	17,437	17,246	12,261	---	237	41,433	2,155
LaSalle	4,301,278	6,122	90,181	480	3,458,390	628,300	41,798	56
Ouachita	1,729,571	839	87,906	111	1,320,608	231,037	1,695	---
Pointe Coupee	672,677	19,734	133,324	26,758	178,438	33	91,248	41,105
Richland	207,062	1,537	131,159	6,283	12,773	2,583	10,402	197
St. Landry	379,240	16,820	150,012	46,258	---	177	39,823	25,628
St. Martin	86,214	2,092	189	1,338	---	89	11	81,881
St. Mary	83,321	---	153	---	26,408	125	---	---
Tensas	680,134	6,228	185,966	32,262	135	394	111,939	42,686
Terrebonne	5,338	2,301	2,036	156	---	---	845	---
West Baton Rouge	18,526	188	1,633	770	---	37	1,327	362
TOTAL	$13,483,665	$124,436	$1,295,510	$282,271	$8,094,129	$1,170,864	$500,007	$301,883
Percent of State	11.3	68.4	34.0	73.8	9.0	6.5	39.0	51.0
LOUISIANA	$118,950,295	$181,995	$3,810,257	$382,604	$89,987,722	$17,999,839	$1,281,402	$591,858

Source: Louisiana Forestry Commission, "1976 Timber and Pulpwood Production in Louisiana".

INDUSTRY

A.5.269. The manufacturing sector of the economic area has been boosted by the expansion of the petrochemical industry in south Louisiana. Manufacturing employment (Table A-5-33) in the study area in 1954 amounted to 17,317 with an annual payroll of about $50.2 million. Between 1954 and 1977, such employment increased to 34,900, or 101.5 percent, with the annual payroll expanding to $447.5 million, or 791 percent. These growths in employment and annual payroll over the 1954-72 period greatly exceeded comparable statewide figures of 34.2 and 403 percent, respectively.

A.5.270. Value added by manufacture in the study area in 1977 was $1,527.3 million, or 16.1 percent of the statewide total. Important classifications of the manufacturing sector within the economic area include industries associated with the processing of chemicals, including industrial and miscellaneous chemicals and allied products, food and kindred products, sugar, and lumber and wood products. Boat-building facilities, printing and publishing, and the manufacture of transportation equipment are other significant economic factors in this sector.

PARKS AND RECREATION

A.5.271. The Lower Atchafalaya Basin Floodway is largely undeveloped from the standpoint of parks and recreation, but with the advent of a newly found environmental awareness on the national level, people of all ages are being drawn to environmentally unique areas, like the basin, to seek out and enjoy nature's beauty. Also, as previously stated, the mode of existence for basin dwellers has traditionally been based on a livelihood of hunting, fishing, and gathering. These activities have evolved into recreational pursuits that occur today by those who follow their ancestoral tradition of using the swamp's resources--the full potential of which has yet to be realized. Most important of these activities are fishing and hunting, along with crawfishing, camping, boating, swimming, and many others.

A.5.272. Limiting Factors. Recreational use of the Lower Atchafalaya Basin Floodway is limited in scope and intensity because of public access. Although water bottoms and accretion areas are claimed in state ownership, almost all land areas and many water access areas are privately-owned. Some state-owned lands are posted against public use by the adjacent landowners or their leasees. Posting of private lands by owners or lessees has deterred general public use and has severely limited the market potential for public recreational development. In addition, state-claimed land is often posted by adjacent landowners or lessees, compounding the problem of public access.

TABLE A-5-33

MANUFACTURING DATA

Parish	Employment 1954	Employment 1963	Employment 1972	Employment 1977	Annual Payroll ($1000) 1954	Annual Payroll ($1000) 1963	Annual Payroll ($1000) 1972	Annual Payroll ($1000) 1977	Value Added ($1000) 1954	Value Added ($1000) 1963	Value Added ($1000) 1972	Value Added ($1000) 1977
Assumption	$ 838	$ 794	$ 700	500	$ 2,376	$ 3,751	$ 5,500	5,500	$ 9,817	$ 16,941	$ 12,200	12,200
Avoyelles	516	295	500	1,100	1,233	1,071	2,700	7,300	2,364	2,994	8,000	21,000
Caldwell	132	117	300	1/	243	308	2,100	1/	375	225	4,500	1/
Catahoula	172	223	1/	1/	353	1/	1/	1/	540	1/	1/	1/
Concordia	196	285	400	1/	391	916	1,800	1/	512	1,520	2,600	1/
Franklin	124	365	500	500	265	1,026	2,200	3,500	725	1,807	3,300	9,300
Iberia	1,043	1,677	2,000	4,000	2,824	6,567	13,100	43,000	5,451	15,597	36,100	94,400
Iberville	631	1,096	2,200	3,500	1,462	6,874	26,400	68,900	2,181	39,894	254,500	634,600
Lafourche	1,584	1,666	2,200	2,600	4,645	7,675	15,900	31,400	6,800	21,174	31,000	73,100
LaSalle	775	623	1,200	1,200	1,912	2,013	7,800	11,100	2,721	4,024	24,400	52,000
Ouachita	5,402	5,723	6,400	7,700	19,951	30,507	57,100	113,000	51,540	65,914	126,500	245,000
Pointe Coupee	352	278	200	1/	717	849	900	1/	1,467	1,634	2,400	1/
Richland	101	248	700	600	238	759	3,600	4,700	446	1,699	6,300	8,300
St. Landry	1,002	878	1,200	1,900	2,434	2,964	7,000	16,600	4,737	7,930	14,500	41,800
St. Martin	368	419	1,200	2,300	910	1,127	5,500	16,500	1,315	3,338	8,500	23,300
St. Mary	1,800	2,030	4,300	5,500	5,490	8,756	37,700	81,200	12,758	30,786	98,700	199,900
Tensas	242	146	1/	1/	569	1/	1/	1/	849	1/	1/	1/
Terrebonne	1,875	1,841	3,700	3,000	3,833	7,384	29,700	38,000	8,218	15,741	59,300	75,800
W. Baton Rouge	164	229	300	500	362	821	2,800	6,800	968	1,984	10,500	36,400
TOTAL	$ 17,317	$ 18,933	$ 28,000	$34,900	$ 50,208	$ 83,368	$221,800	$447,500	$113,784	$233,202	$703,300	$1,527,300
Percent of State	12.0	13.6	15.6	18.0	9.4	10.8	13.8	16.7	9.6	12.2	16.4	16.1
LOUISIANA	$144,757	$139,511	$179,600	$194,200	$531,639	$769,410	$1,602,300	$2,673,700	$1,181,649	$1,915,625	$4,282,400	$9,503,100

1/ withheld to avoid disclosure of information.

Source: US Department of Commerce, Bureau of the Census, "Census of Business, Manufacturing, Louisiana", 1958, 1963, 1972, 1977.

A.5.273. The Lower Atchafalaya Basin Floodway, contains large rivers, lakes, bayous, swamps, and bottomland hardwood forests, and experiences seasonal inundation of varying stages. Recreation development that has occurred in the northern portion of the floodway around I-10 is not large in scale and is subject to periodic flooding.

A.5.274. Private ownership and the flooding of large areas have limited the use and access within the basin. Major east-west highways, including I-10, US Highways 190 and 90, cross the basin at its northern and southern extremities and offer limited access. Parish highways follow north-south routes paralleling the basin or running on top of the floodway protection levees. Interior access in the basin is primarily by boat, with interior land access to the public occurring in very few places.

A.5.275. Mineral extraction within the floodway is not a major impediment to recreation, since it does provide some access; however, it also deters some uses within the basin. Channelizing for operational access alters natural flow patterns and sedimentation rates; pipelines and storage tanks present obstacles to some uses, and visual and audio esthetics are often destroyed. Mineral extraction is a disruptive factor to the recreational attractiveness of the basin in areas where it is concentrated.

A.5.276. Trapping, commercial fishing, crawfishing, and timber harvestings are not considered as direct threats to potential recreational uses, but do compete for the same resources upon which current recreational pursuits depend. Habitat destruction, caused by agricultural land clearing and clearcut timber harvests, is a threat to hunting and fishing resources. These land-clearing practices reduce the existing resource base and degrade water quality, thereby decreasing associated recreational values. However, cleared lands would offer potential for some forms of recreation not now common to the basin, such as upland game hunting.

A.5.277. The existing physical condition of the basin offers an extensive array of recreational use potential from a nondevelopmental standpoint. Limiting this potential is the lack of adequate secondary support facilities which must be present to accommodate wider usage patterns. The result is that existing use occurs in one of two ways.First, either the individual user is a member of a family group or private club, using its clubhouse or camp as the support facility or is one who engages in day-use activities only. Many private club users are local residents of the area and for them the club is a retreat affording a degree of exclusivity. The second type of use is by the day-user (normally fishermen) who, by virtue of the time/distance allocation, is also a resident of the local area. These use patterns, as indicated in the "1971-1974 Atchafalaya Basin Usage Study," do impact the basin by shrinking the potential market area of the Lower Atchafalaya Basin Floodway and placing a heavy reliance on local populations for the majority of recreation use.

A.5.278. In the "1971-1974 Atchafalaya Basin Usage Study," prepared cooperatively by the US Army Corps of Engineers, New Orleans, and the Louisiana Department of Wildlife and Fisheries, responses indicated that 50 percent of all users came from within a 25-mile radius and 90 percent within a 50-mile radius. The average round-trip distance traveled was 62 miles. These responses identified the majority of existing users as individuals who, by residing and/or working in or close to the Atchafalaya Basin, have acquired the means to access and use the basin for recreational purposes.

A.5.279. Existing Recreation Inventory. The existing recreation lands and facilities located in or near the Atchafalaya Basin can be categorized into two groups: public use, which includes commercial establishments that serve the public on a fee basis, and private exclusive use.

A.5.280. Boat launching ramps are the most numerous public facilities in terms of recreational development (Figure A-5-18). Public ramps are constructed of gravel, shell, or concrete and are often adjoined by parking lots of variable sizes. These public ramps are usually maintained either by the Louisiana Department of Wildlife and Fisheries or by the local parish. Many of the existing ramps, however, are not routinely maintained, and are in only fair to poor condition. There is no fee for parking or launching at the public ramps.

A.5.281. Many of the commercial ramp operations, in addition to having boat launching facilities, provide such amenities as bait and fishing tackle, guide service, and groceries. Usually there is a nominal cost for parking and/or launching. Most commercial-type ramps are constructed of concrete and provide a courtesy pier or dock to aid in launching.

A.5.282. Both public and commercial-type boat ramps are interspersed primarily along the floodway's periphery or in the vicinity of Butte LaRose. A listing of these ramps showing location, water access, number of lanes, condition, and available parking is shown in Table A-5-34.

A.5.283. There are several commercially-operated campgrounds located in or near the floodway. They generally offer developed camp sites having electrical and water hookups and sanitary facilities. Campgrounds within the floodway are located at Butte LaRose near I-10, at Butte LaRose Bay, at Highway 190 North Service Road near Bayou Courtableau, and at Big Alabama Bayou. These campgrounds have 140 sites, 10 sites, 50 sites, and 28 sites, respectively. Campgrounds outside the Lower Atchafalaya Basin Floodway that influence use in the floodway are located at Port Barre, Morgan City, and East Lake Dauterive, and have 28, 20, and 15 sites, respectively. There are no publicly-owned and operated campgrounds within the basin at the present time.

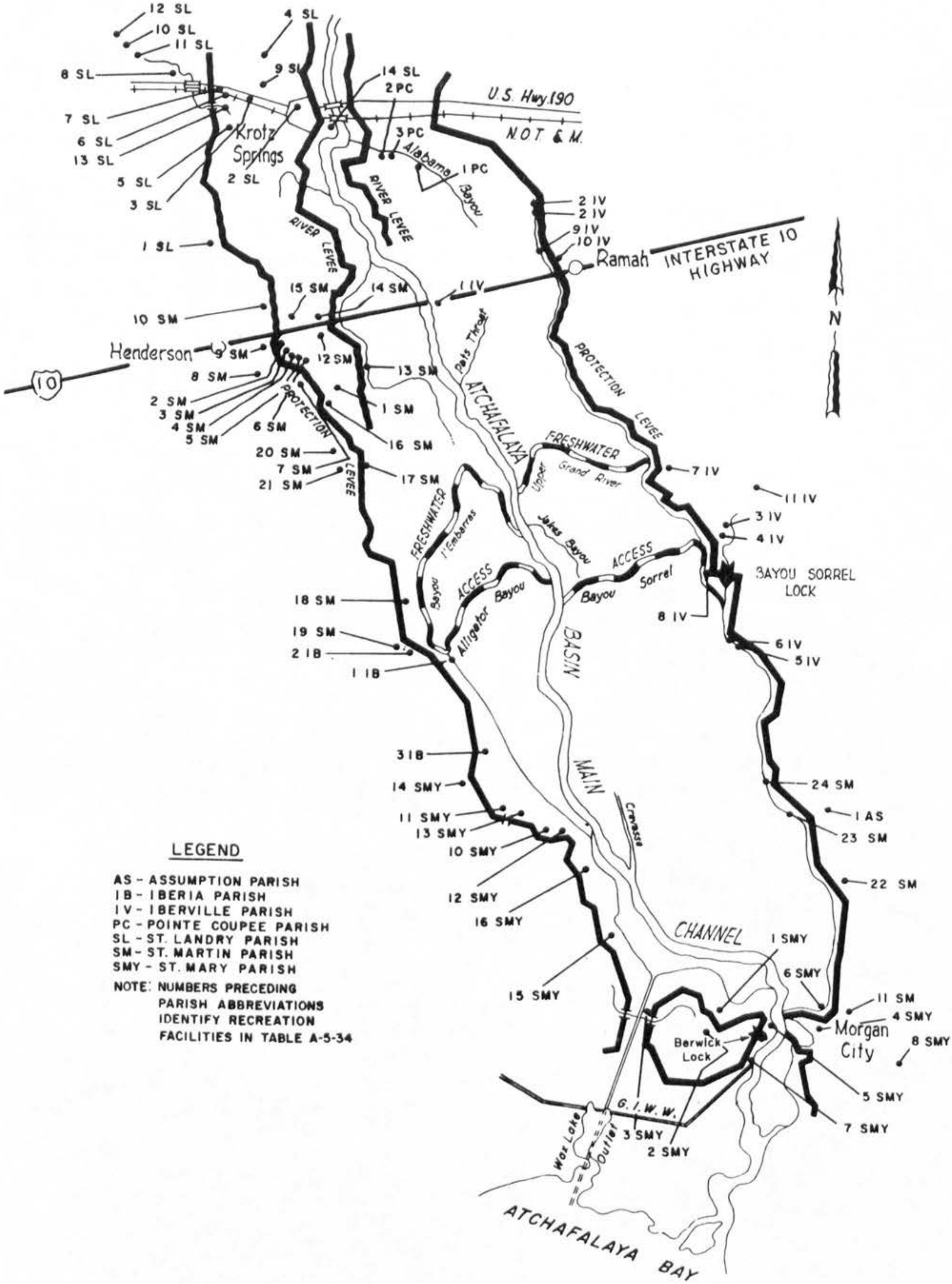


FIGURE A-5-18 EXISTING RECREATIONAL FACILITIES

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Whiskey Bay Pilot Channel	1 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	3	Concrete/ Excellent	Whiskey Bay/ Inside Levee	50	Asphalt
Borrow Pit - Power Lines Power Lines	2 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Shell/ Fair	Borrow Pit/ Inside Levee	30	Shell/Grass
Bayou Plaquemine	3 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Good	Bayou Plaquemine/ Outside Levee	5	Grass
Bayou Plaquemine	4 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Good	Bayou Plaquemine/ Outside Levee	6	Grass
Bayou Pigeon	5 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	3	Shell/ Very Good	GIWW/ Inside Levee	40	Shell
Bayou Pigeon	6 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Very Good	GIWW/ Inside Levee	50	Grass/Shell
Grand River	7 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	1	Shell/ Fair	Grand River/ Outside Levee	50	Shell
Bayou Sorrel	8 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Good	Bayou Sorrel/ Inside Levee	60	Shell
Borrow Pit Above Ramah	9 IV	Iberville	Commercial	Boat Access	East of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	20	Grass
Ramah	10 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	1	Dirt/ Poor	Borrow Pit/ Inside Levee	20	Dirt
Jack Miller's	11 IV	Iberville	Public	Boat Access	East of Atchafalaya River Channel	10	Gravel/ Poor	Bayou Plaquemine/ Outside Levee	10	Gravel
Bayou Peyronnet	1 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Borrow Pit/ Outside Levee	8	Shell
Brushy Bayou	2 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Dirt/ Poor	Borrow Pit/ Above Hwy. 190 Inside Levee	8	Grass/Shell
Nall's Landing	3 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	2 O'Clock Bayou/ Inside Levee	20	Grass/Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
D'Arbonne Bay at Hwy. 71	4 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Brushy Bayou/ Inside Levee	7	Shell/Grass
Earl's Landing	5 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	2	Shell/ Fair	Bayou Courtableau Drainage Structure/ Inside Levee	5	Shell
RR Bridge and Hwy. 190	6 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Gravel/ Fair	Bayou Courtableau/ Inside Levee	15	Gravel
Hwy. 190 South Under Bridge	7 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Bayou Courtableau/ Inside Levee	15	Shell
Jim's Landing on Hwy. 190	8 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	1	Gravel/ Fair	Bayou Courtableau/ Outside Levee	10	Shell
Atchafalaya Basin Wilderness Camp	9 SL	St. Landry	Commercial	50-unit Campground 5 Picnic Areas	West of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	10	Grass/Shell
Port Barre Landing	10 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Bayou Courtableau/ Outside Levee	20	Shell/Grass
Veteran Memorial Park	11 SL	St. Landry	Public	3 Picnic Areas, 2 Tennis Courts, 1 Basketball Court, 1 Playground, 1 Playfield	West of Atchafalaya River Channel	--	--------	--------	--	--------
Birthplace of Teche Campground	12 SL	St. Landry	Commercial	28-unit Campground	West of Atchafalaya River Channel	--	--------	--------	--	--------
Jim's Landing	13 SL	St. Landry	Commercial	Boat Access	West of Atchafalaya River Channel	2	Shell/ Fair	Borrow Pit/ Inside Levee	15	Gravel
Atchafalaya River at Krotz Springs	14 SL	St. Landry	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	Atchafalaya River/ Inside Levee	20	Shell/Grass
Aunt Jane's Place	1 SMY	St. Mary	Commercial	Boat Access	Southwest of Atchafalaya River Channel	1	Shell/ Fair	Lower Atchafalaya River/Inside Levee	15	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
St. Mary Parish	2 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	2	Concrete/ Good	Bayou Teche/ Outside Levee	10	Shell
Wax Lake Outlet	3 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Concrete/ Very Good	Wax Lake/ Inside Levee	50	Grass
Lake End Park	4 SMY	St. Mary	Public	20-unit Campground 10 Picnic Sites	East of Atchafalaya River Channel	5	Concrete/ Very Good	Lake Palourde/ Outside Levee	15	Shell
Casso's Landing	5 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Good	Atchafalaya River/ Inside Levee	10	Shell
Joe Russo Memorial Landing	6 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW/ Inside Levee	65	Shell
St. Mary Parish	7 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW-Lower Atchafalaya River/ Inside Levee	100	Grass/Shell
Marcell Memorial Landing	8 SMY	St. Mary	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	Bayou Boeuf-GIWW/ Inside Levee	60	Gravel/Grass
West of Myette Point	10 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	4	Concrete/ Good	Grand Lake/ Inside Levee	20	Grass
Charenton Structure	11 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	4	Shell/ Fair	Grand Lake/ Inside Levee	6	Shell
Myette Point #2	12 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Shell/ Fair	Grand Lake/ Inside Levee	5	Shell
F.C. Viguerie	13 SMY	St. Mary	Commercial	Boat Access	West of Atchafalaya River Channel	12	Shell/ Fair	Grand Lake/ Inside Levee	40	Grass/Shell
Grand Avoille Cove	14 SMY	St. Mary	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Grand Avoille Cove/Outside Levee	20	Grass
Verdonville	15 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	1	Concrete/ Good	Grand Lake/ Inside Levee	15	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Miller Point	16 SMY	St. Mary	Public	Boat Access	Southwest of Atchafalaya River Channel	2	Dirt/ Poor	Grand Lake/ Inside Levee	8	Gravel
Fish Island	1 IB	Iberia	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Fausse Point Cut/Inside Levee	40	Shell
Sand Bar Park/ Fausse Point Recreation Area	2 IB	Iberia	Public	Park, Camping, Picnicking	West of Atchafalaya River Channel	1	Shell/ Good	Lake Fausse Point/ Outside Levee	20	Shell
South Little Lake Long	3 IB	Iberia	Public	Boat Access	West of Atchafalaya River Channel	3	Concrete/ Good	South Little Lake Long/Inside Levee	30	Grass/Shell
Lake Verret	1 AS	Assumption	Public	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Very Good	Lake Verret/ Outside Levee	35	Shell
Big Alabama Campground	1 PC	Pointe Coupee	Commercial	28-unit Campground with water, electricity, and sewage	East of Atchafalaya River Channel	2	Concrete/ Good	Big Alabama Bayou/Inside Levee	25	Grass
Jim's Boat Landing	2 PC	Pointe Coupee	Commercial	Boat Access	East of Atchafalaya River Channel	2	Concrete/ Good	Big Alabama Bayou-Little Alabama Bayou/Inside Levee	30	Shell
Uncle Dick Davis Park	1 SM	St. Martin	Commercial	Boat Access Park, 10-unit Campground	West of Atchafalaya River Channel	1	Shell/ Fair	Butte LaRose Bay/ Inside Levee	5	Grass/Shell
Wiltz Landing	2 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	3	Concrete/ Very Good	Henderson Lake/ Inside Levee	20	Shell/Grass
Pat's Landing	3 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	2	Concrete/ Good	Henderson Lake/ Inside Levee	20	Gravel
Atchafalaya Basin Landing	4 SM	St. Martin	Commercial	Boat Access Bait Shop Boat Rental	West of Atchafalaya River Channel	3	Concrete/ Good	Henderson Lake/ Inside Levee	30	Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
McGee's Landing	5 SM	St. Martin	Commercial	Bait Shop Boat Rental Tours	West of Atchafalaya River Channel	2	Concrete/ Good	Henderson Lake/ Inside Levee	25	Gravel/Grass
G&L Landing	6 SM	St. Martin	Public	Abandoned Boat Access	West of Atchafalaya River Channel	1	Concrete/ Fair	Henderson Lake/ Inside Levee	10	Shell/Grass
CAP Hedges Landing	7 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Bayou Berard/ Outside Levee	20	Grass/Shell
Henry Guidry Memorial Park	8 SM	St. Martin	Public	Day Use Park	West of Atchafalaya River Channel	--	-----	--------	--	--------
Tom Huval Landing	9 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Very Good	Bayou Peyronnet/ Outside Levee	15	Gravel
Bayou Peyronnet	10 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Poor	Bayou Peyronnet/ Outside Levee	4	Shell
Brownell Memorial Park	11 SM	St. Martin	Public	9.5-acre Memorial Park and Nature Trail	East of Atchafalaya River Channel	--	-----	--------	--	--------
Frenchman's Wilderness	12 SM	St. Martin	Commercial	140-unit Campground	West of Atchafalaya River Channel	--	-----	--------	--	--------
Butte LaRose	13 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	2	Concrete/ Good	Upper Grand River/Inside Levee	40	Shell
I-10 Rest Stop	14 SM	St. Martin	Public	Rest Stop Picnic Area	West of Atchafalaya River Channel	--	-----	--------	--	--------
Pelba	15 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	3	Concrete/ Excellent	Lake Bigeux/ Inside Levee	50	Asphalt
Gaging Station	16 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/ Fair	Borrow Pit/ Inside Levee	20	Gravel
Borrow Pit near Bayou Mercier	17 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Crocodile Bayou/ Inside Levee	20	Grass/Shell
Bayou Benoit	18 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Bayou Benoit/ Inside Levee	40	Grass/Shell

TABLE A-5-34
EXISTING RECREATIONAL FACILITIES INVENTORIES
(Continued)

Facility Name	Facility Number	Parish	Ownership	Facility	Basin Location	Launch Lanes	Type/ Condition	Water Access	Parking Spaces	Parking Surface
Lake Dauterive	19 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Concrete/ Very Good	Dauterive Lake/ Outside Levee	8	Shell
St. Martin Parish Ward 3	20 SM	St. Martin	Public	Boat Access	West of Atchafalaya River Channel	1	Shell/Con-crete/Good	Bayou Mercier/ Outside Levee	20	Grass/Shell
Clayton Boudreaux Memorial Park	21 SM	St. Martin	Public	Day Use Park and Picnic Area	West of Atchafalaya River Channel	--	-----	--------	--	--------
Adam's Landing	22 SM	St. Martin	Commercial	Boat Access	East of Atchafalaya River Channel	2	Shell/ Fair	Belle River/ Outside Levee	20	Shell
Belle River Bridge	23 SM	St. Martin	Public	Boat Access	East of Atchafalaya River Channel	3	Shell/ Fair	GIWW/ Inside Levee	10	Shell
Belle River	24 SM	St. Martin	Public	Boat Access	East of Atchafalaya River Channel	4	Concrete/ Very Good	GIWW/ Inside Levee	10	Shell

A.5.284. Only a few locally established day-use parks presently exist near the basin. These are found in the communities of Port Barre, Henderson, and Catahoula. The parks generally provide picnic shelters, multipurpose playfields and courts, and playgrounds which sustain a variety of day-use activities.

A.5.285. A state-operated public rest stop and picnic area located at the I-10/Butte LaRose interchange provides two restrooms, 50 picnic tables, and 35 picnic shelters equipped with barbecue braziers.

A.5.286. The Original Swamp Gardens of Morgan City offer an interpretive presentation of the great Atchafalaya Basin swampland. Although this combination living museum and park encompasses only 3.5 acres, it tells a large-scale story of the people who have historically made the swamp their home. The park is highlighted by replicas of swamp-dwellers engaged in traditional activities, as well as live exhibits of native flora and fauna displayed in their natural environment.

A.5.287. Situated just outside the floodway on the west side of Lake Palourde is the Brownell Memorial Park. This scenic park of 9.5 acres is open to the public and, along with its Carillon Tower, provides a nature trail characterized by many varieties of native flora.

A.5.288. The State of Louisiana has diverse land holdings within or near the basin which are recreational in nature. The Attakapas Wildlife Management Area, the center of which is located 20 miles northwest of Morgan City, encompasses 25,500 acres and is accessible only by boat. Future plans include a headquarters building and boat landing to be built adjacent to the West Atchafalaya Basin Protection Levee about 8 miles northeast of Franklin. The Atchafalaya Delta Wildlife Management Area is comprised of some 125,000 acres of accreting delta located at the mouth of the Atchafalaya River in St. Mary Parish. Approximately 25,000 acres of this delta area are above the water surface. Three other state wildlife management areas are located in the market area within Avoyelles Parish. Grassy Lake encompasses 12,500 acres, Pomme de Terre has 4,591 acres, and Spring Bayou totals 11,237 acres. Each of these areas has at least one primitive camping area available for public use. Thisthlethwaite Wildlife Management Area, located in St. Landry Parish, provides 11,100 acres for hunting. No camping is available, but nonhunting activities include nature walks and nature photography. All of these areas are under the jurisdiction of the Louisiana Department of Wildlife and Fisheries and are primarily used for public hunting and/or fishing.

A.5.289. The State Lands Division, Department of Natural Resources, administers a campsite leasing program which includes 218 sites averaging one-half acre in size situated on 11,833 acres in or near the basin. These sites are leased or available for lease by the general public on a bid basis for periods of 10 years. In addition,

any lands in the basin under the jurisdiction of the State Lands Division and undivided under the Campsite Leasing Program remain open to public use.

A.5.290. The Louisiana Office of State Parks, Department of Culture, Recreation and Tourism, has several projects in different stages of development that are located close to the Atchafalaya Basin. Eight thousand acres of land have been acquired for the development of Lake Fausse Point State Park, located just outside of the West Atchafalaya Basin Protection Levee at Lake Fausse Point in Old Bird Island Chute. Initial development, which will occupy 150 acres, consists of building an access road, bridge crossing, clearing and grubbing 75 camping spurs, and constructing eight cabins, each having an occupancy of six. A boat-launching ramp into Bird Island Chute on Lake Fausse Point will be constructed, as well as two large picnic pavillions. When this park is completed, the bulk of the total acreage will be undeveloped and managed as a wildlife preserve.

A.5.291. The Atchafalaya Wilderness Center, when developed, will be classified as a State Preservation Area that offers environmental interpretation, outdoor education, and passive recreation. This center, which will be located just southeast of Catahoula and adjacent to the West Atchafalaya Basin Protection Levee, will be sited on a 450-acre tract of land, of which 400 acres have already been acquired by the state. Bayou Berard flows to the west of the site, providing a water linkage to Lake Dauterive to the south. The interpretive theme of the wilderness center will focus on Acadian culture and the relationship of its evolution to that of the basin. The site was selected for development because of the existing indigenous flora and fauna which characterize the early basin, and also because of the ready accessibility of the basin to the visiting public. A scheduled completion date for the center has not been determined.

A.5.292. Another facility under construction by the Office of State Parks is an interpretive center located at the Plaquemine locks on the Mississippi River. An amphitheater and a tower overlooking the site are planned. The center's interpretive theme will address the historical role of the locks, which date back to the early 1900's, and their relationship to the Mississippi River and Atchafalaya Basin. Initial development is scheduled for completion in 1981.

A.5.293. Two other state parks and one state monument are located in the market area but are somewhat remote from the floodway. Chicot State Park, located 10 miles north of Ville Platte, Louisiana, contains about 6,840 acres. Lake Chicot includes 2,500 acres and is the focal point of recreation. Noted for its scenic beauty, the park is developed for tent and trailer camping along the lakeshore. Trails provide hiking opportunities for nature observers and a 300-acre arboretum is located on the park grounds. Chicot State Park receives heavy use and offers potential for further development for camping, picnicking, fishing, and other outdoor recreational activities.

A.5.294. Longfellow-Evangeline State Park is located in St. Martin Parish on the banks of Bayou Teche in the town of St. Martinville, Louisiana. Development at the park consists of an Acadian House Museum, picnic shelters and tables, and camping facilities. The park lodge is operated as a restaurant. This heavily used park attracts visitors nationwide.

A.5.295. Edward Douglas White Memorial State Monument is located 4 miles north of Thibodaux, Louisiana, off Louisiana Highway 1. The raised cottage, now well over 100 years old, has been restored and contains some of its original furniture.

A.5.296. Other recreation development in the natural basin below the latitude of Simmesport consists primarily of boat-launching ramps and private hunting and fishing camps located along bayous, lakes, and rivers, as well as the Lower Atchafalaya Basin Floodway. Picnic facilities or small day-use parks are scattered in and around towns and municipalities.

A.5.297. Of the 595,000 acres which lie within the study area below US Highway 190, approximately 80 percent is privately-owned. It has been estimated that more than 250 private hunting clubs, many having their own permanent camps, are located in this portion of the basin, predominately in the north. In addition, many privately-owned residential-type camps and houseboats are scattered throughout the basin and are used by their owners or occupants for weekend outings.

A.5.298. Present Recreational-Use Patterns. The Lower Atchafalaya Basin Floodway contains an abundant supply of natural resources. It is this mix of resource types that supports such a diverse potential for recreational use of land and water within the floodway's limits.

A.5.299. Because of higher land elevations in the upper portion of the basin, recreational facilities development, although minimal, is more extensive than those in the lower portions where access is limited and the wetter terrain of swamps and marshlands hinder development. It is this northern portion that attracts the greatest amount of use associated with sport hunting, one of the most actively pursued recreational activities in the study area. Most big game hunting is permitted exclusively by hunting lease. Hunting clubs have their own permanent camps, the use of private posted hunting land, and limited memberships. It is estimated that there were over 250 active hunting leases in the basin in 1980. These clubs are generally located in areas wherever suitable white-tailed deer habitat occurs. White-tailed deer is the main big game species hunted. Black bear hunting, in the area of Lottie between I-10 and LA 10, is limited to the harvest of one bear per day, one bear per season. A turkey flock has been established in the same general area in the upper basin, with a 37-day season already established. The limit is one gobbler per day, three per season. Small game hunting occurs in many of the same

areas as big game hunting. In addition, public lands at various locations within the floodway provide for public hunting of small game, especially rabbits. Some dove hunting occurs over cultivated fields in the northern portion of the basin and squirrels are fairly abundant.

A.5.300. Hunting of migratory gamebirds is an equally important recreational pursuit that occurs in many areas of the basin, as well as in the delta region. These areas of high-quality habitat lie within the Mississippi Flyway and provide some of the best duck hunting in the United States. The Atchafalaya Delta Wildlife Management Area is state-owned and available for public use. Bottomland hardwood stands provide prime habitat for woodcock that winter in the basin. American woodcock hunting is a specialized type hunting; however, many are killed incidental to participation in other types of hunting.

A.5.301. Fishing is probably the most important water-based recreational activity in the Atchafalaya Basin. Wherever there is ample water, fishing is evident; but certain areas do have a higher use because of quality habitat or ease of access. Organized tournament bass fishing has grown in popularity in recent years. As many as 10 different bass clubs and organizations, such as the Lions Club and Kiwanis Club from the Lafayette area, hold tournaments and fishing rodeos out of the Old McGee's Landing on Henderson Lake. Clubs from Houma and Thibodaux fish in a similar manner in the southernmost part of the basin. Within the last couple of years, the basin has supported a national bass fishing tournament sponsored by Bass Masters, Inc. Some of the more noteworthy boat fishing areas are located at Henderson Lake, Cow Island Lake, Lost Lake, Warner Lake, Buffalo Cove, and the Upper Grand River flats. However, not much sport fishing occurs in the river. Several lakes located on the basin's periphery, such as Lake Fausse Point, Lake Palourde, Lake Dauterive, and Lake Verret, offer clear water and good fishing.

A.5.302. Most bank fishing occurs along the borrow pits that line the protection levees on either side of the basin. Much of this land, however, is privately-owned and posted against public use. Some of the areas that most heavily support bank fishing are along US Highway 190's south service road, the pontoon bridge near Butte LaRose ridge, areas along either side of the levee north of Ramah, and areas adjacent to most boat ramps. Both boat and bank fishing activities occur year-round in the basin, with weekend use being the heaviest.

A.5.303. Noncommercial crawfishing is classified as a consumptive recreational pursuit. As opposed to commercial and some sport crawfishing, which is accomplished by boat in the basin's interior, most sport crawfishing is pursued along the floodway levee system, accessible by vehicle. Access to the water, however, is a problem in some areas because of private, posted land. The areas where public

crawfishing is concentrated are the Henderson to Catahoula levee, the south side of Butte LaRose ridge, the river levee south of I-10, and near Morgan City and Ramah. Crawfishing occurs from February through May in these areas provided that water levels are high enough to sustain it. Many families engage in this activity, mostly on weekends, and its popularity is growing.

A.5.304. Frogging is another water-based consumptive recreational activity that is actively pursued in basin-wide. It is not as intensive a use as fishing or crawfishing, but a genuine interest is reflected in it by advocates of the sport. Frogging occurs generally in the summer months, usually in cypress-tupelo back swamps. It generally occurs at night, and most participants are local people who know their way around the basin. Bullfrogs are sought throughout the area and pigfrogs are sought in the coastal areas.

A.5.305. There are areas in and around the basin which support sport crabbing. In many instances, sport fishermen will throw out crab nets while they fish, but experienced individuals who want to crab specifically concentrate their efforts at Charenton, Lake Dauterive, and areas south of Morgan City. This activity occurs mostly in the summer season and results in the catching of the blue crab.

A.5.306. There are many water-based nonconsumptive type recreational activities that are being pursued with greater intensity and frequency in the Atchafalaya Basin. This has been caused partly by a renewed public awareness and interest in the environment during the last decade, and the relative economy of engaging in nature study and appreciation as opposed to absorbing consumptive recreational costs. The size and environmental diversity of the basin offer many opportunities for such recreational pursuits.

A.5.307. Canoeing is becoming quite popular in the basin. Two commercial operations in Lafayette and two in New Orleans offer nationally-advertised guided canoe sorties into the basin. Additionally, local environmental groups sponsor canoe trips several times each year. Canoeists usually seek out fairly accessible bayous that flow through scenic swamps of cypress and tupelo. These areas are found at Henderson Lake, Beau Bayou, Bayous Pigeon and Sorrel, the Flats, and Upper Grand River. Canoeing in these areas provides ample opportunity for viewing the natural flora and fauna. With this in mind, most canoeing occurs in the spring and fall when biting insects and hot, humid weather are less intense, but when vegetation is full and more wildlife can be observed.

A.5.308. Some sightseeing tours of the basin are sponsored by local Lafayette hotels in conjunction with the Council for the Development of French in Louisiana, and by commercially-operated tour services in the Henderson Lake area. Pontoon boats or fiberglass hulled boats are used from spring through fall to shuttle small groups of tourists,

many of French nationality, on tours into the basin. As a result, visitors can gain first-hand experience of the basin's swamp environment and perhaps realize the basin's influence on the evolution of the Acadian culture.

A.5.309. Birdwatching, wildlife observation, and nature photography are compatible activities that occur within the basin, often during canoe trips or during guided tours. Although there are concentrations of certain wildlife species in different areas of the basin, such as aquatic birds, alligators, and bears, the basin as a whole offers a wide diversity of flora and fauna that can be easily observed by the nature enthusiast.

A.5.310. Bayou Penchant has been classified as a natural and scenic stream by the State of Louisiana, Department of Wildlife and Fisheries. It is located in the southern part of the basin in Terrebonne Parish and is free flowing and unaltered. Its banks are covered with native vegetation. Areas such as this provide the opportunity for nature study and general enjoyment.

A.5.311. Numerous bird rookeries have been identified in the basin and the breeding bird population occupying them has been estimated at 20,000 plus. In the coastal marshes, the presence of wintering migratory waterfowl and bald eagles, along with the other bird species, provide rewarding birdwatching activities.

A.5.312. Other water-oriented sports, which have attained some degree of participation by basin-goers, are waterskiing and swimming. These are summer activities that occur mostly on weekends. Waterskiers are usually found at Henderson Lake, Bayou Courtableau, and Butte LaRose canal. Those lakes just outside the floodway, such as Lake Verret and Lake Palourde, are heavily used by waterskiers. Swimming is incidental to most other water-oriented activities, as there are no designated swimming areas in the basin at present. Some swimming, however, near launch sites does occur.

A.5.313. Nonconsumptive land-based recreational activities are not as intensely pursued within the basin, since access and the private ownership of land inhibit use by the general public. Yet the potential for expanding recreational use is ever present. Even with existing constraints, some recreational opportunity is afforded the public for use of parts of the floodway and levee system. Sightseeing, driving for pleasure, walking, hiking, and bicycling are all activities that occur generally on the levee roads that outline the floodway. These activities are not heavily concentrated but do occur closer to populated areas. Jogging and running have increased in popularity in recent years and levee roads generally serve as suitable jogging paths. The Acadian Running Club from Lafayette, Louisiana, sponsors an annual event, the Great Atchafalaya Road Race, which follows the levee course from Catahoula to Henderson, a distance of

11 miles. Levees are used on occasion for other activities, such as horseback riding and all-terrain vehicle trails, as well as providing sites for an occasional fish fry or crawfish boil.

A.5.314. As previously noted, most camping is done on private lands in conjunction with hunting. There are also private residential camps established in the basin as "weekend hideaways". These are concentrated in such areas as Henderson, Butte LaRose Bay, Bayou Chene, Alabama Bayou, Bayou des Glaises, and Bayou Courtableau. A flotilla of private houseboats that serve as camps is located in the Cocodrie area. Only a few commercially-operated public campgrounds are located in or near the basin floodway. They are used most heavily during the summer.

A.5.315. Other public camping occurs in very primitive areas on the elevated banks along the basin's interior waterways, and in wildlife management areas during hunting season. The Atchafalaya Delta Wildlife Management Area has designated certain sites as primitive camping areas, used mostly by hunters.

A.5.316. Most land-based nature study occurs adjacent to the levees at the land-water interface and on public lands. Although there is a potential for additional environmental interpretation areas near or in the basin, several existing interpretive facilities provide for public awareness of the project-related environment. Brownell's Memorial Park and the Original Swamp Gardens, both located near Morgan City, draw many local and distant visitors because of their basin-related attractions, such as native flora and fauna, history, and Acadian culture. In addition, many local communities sponsor their own cultural and heritage festivals that relate to the overall influence of the Atchafalaya Basin. Breaux Bridge has its annual Crawfish Festival, New Iberia hosts the Sugar Cane Festival, and Lafayette stages its Festival Acadien, to name a few. As many as 50,000 people are often attracted to these festivals where eating, drinking, dancing, and celebrating is the order of the day, and people enjoy numerous fun-filled activities related to the traditions and culture of the area.

A.5.317. The Atchafalaya Basin in its diversity has become a focal point for existing regional recreational opportunity and offers future potential. The fact that it is the nation's largest remaining bottomland hardwood swamp-river overflow ecosystem, has one of the few active river deltas in the world, provides the largest commercial crawfish catch in the world, and today may harbor the last of the ivory-billed woodpeckers, adds to its attraction base.

FISHING, HUNTING, AND TRAPPING (COMMERCIAL ASPECTS)

A.5.318. The waterways and wetlands of the Atchafalaya Basin area have generated and support a thriving commercial fishing industry. In the Atchafalaya Basin, crawfish, buffalo, and catfish comprise the species of major importance in terms of pounds and value. Table A-5-35 shows the catch and value over the 1976-1979 period. Crawfish, buffalo, and catfish accounted for over 92 percent of the value of the catch from the basin during 1979.

A.5.319. Trapping makes a substantial contribution to the Louisiana economy, amounting to millions of dollars. Trapping's contribution to the state economy, as well as the contribution of the Atchafalaya Basin for three selected species, is presented in Table A-5-36. Table A-5-37 demonstrates the overwhelming importance, in the Atchafalaya Basin, of the three species presented in Table A-5-36. By this estimate, they account for approximately 96 percent of the value of trapping during each of the three years. Table A-5-38 presents the most recent data on numbers and value of the three dominant Atchafalaya Basin species.

TABLE A-5-35

COMMERCIAL ASPECTS OF FISH AND SHELLFISH

Species	1976 Pounds	1976 Value $	1977 Pounds	1977 Value $	1978 Pounds	1978 Value $	1979 1/ Pounds	1979 1/ Value $
BOWFIN	13,200	945	11,500	1,014	3,700	356	13,600	1,406
BUFFALO	726,900	108,587	836,200	129,733	1,365,700	231,959	2,055,400	353,113
CARP	105,100	4,272	59,800	2,959	61,500	3,235	131,800	10,128
CATFISH	644,600	225,585	631,900	228,216	660,400	270,170	613,600	255,509
GARFISH	75,900	11,029	93,700	15,996	130,500	25,375	158,500	34,280
PADDLEFISH	3,100	249	2,700	254	14,900	1,759	30,600	3,349
FRESHWATER DRUM	354,300	52,582	345,500	52,448	203,900	32,307	527,600	87,068
SHAD	573,100	21,735	654,600	31,039	413,100	25,644	474,100	48,343
CRAWFISH	5,620,100	1,692,063	1,310,900	708,413	13,941,700	4,107,092	5,524,500	1,981,940
FW TURTLE	9,100	4,013	6,900	3,247	13,400	5,016	29,900	16,249
FROG	25,000	19,075	21,000	19,969	33,500	47,492	15,400	15,166
RIVER SHRIMP	2,500	1,750	2,000	1,392	4,800	3,663	8,500	6,376
TOTAL	8,152,900	2,141,885	3,976,700	1,194,680	16,847,100	4,754,068	9,583,500	2,812,927

1/ Preliminary, subject to revision

Source: National Marine Fisheries Service as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin", F. W. Bell, 1981.

TABLE A-5-36
COMPARATIVE ANALYSIS: LOUISIANA VERSUS ATCHAFALAYA
RIVER BASIN IN FUR HARVEST

Species	Louisiana	Atchafalaya	Percent of State
Nutria		Number	
1971-72	1,286,622	9,000	0.7
1972-73	1,611,623	42,000	2.6
1973-74	1,749,670	30,000	1.7
		Value ($)	
1971-72	4,146,488	24,000	
1972-73	6,737,774	136,000	2.0
1973-74	8,998,020	119,000	1.3
Raccoon		Number	
1971-72	80,632	9,000	11.2
1972-73	149,274	10,000	6.7
1973-74	184,688	9,000	4.9
		Value ($)	
1971-72	237,212	30,000	
1972-73	821,733	57,000	6.9
1973-74	1,317,660	61,000	4.6
Mink		Number	
1971-72	24,299	3,000	12.3
1972-73	44,062	6,000	13.6
1973-74	38,940	2,000	5.1
		Value ($)	
1971-72	97,196	14,000	14.4
1972-73	264,372	37,000	14.0
1973-74	272,580	13,000	4.8

Source: "Atchafalaya Basin Usage Study," 1975, as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin", F. W. Bell, 1981.

TABLE A-5-37

COMMERCIAL FUR CATCH IN THE ATCHAFALAYA RIVER BASIN 1/
(In Thousands)

Species	1971-72 Number	1971-72 Value ($)	1972-73 Number	1972-73 Value ($)	1973-74 Number	1973-74 Value ($)
Nutria	9	24	42	136	30	119
Raccoon	9	30	10	57	9	61
Mink	3	14	6	37	2	13
Muscrat	0	0	1	3	1	1
Beaver	2/	1	0	0	0	0
Opossum	0	0	0	0	2/	2
Other	0	0	0	0	2/	4
TOTAL		69		233		199

1/ Day totals only
2/ Less than 0.5

Source: "Atchafalaya Basin Usage Study", 1975, as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin", F. W. Bell, 1981.

TABLE A-5-38

ESTIMATED GROSS RECEIPTS FROM TRAPPING

Species	Louisiana Number	Louisiana Value	Atchafalaya Basin [1/] Number	Atchafalaya Basin [1/] Value
		1977-78		
Nutria	1,714,083	$ 8,263,373	25,711	$123,950
Raccoon	192,845	1,967,022	14,463	147,527
Mink	28,101	252,909	2,950	26,555
		$10,483,304		$298,032
		1978-79		
Nutria	1,145,084	$4,823,094	17,176	$ 72,421
Raccoon	231,747	3,383,507	17,381	253,763
Mink	51,731	465,579	5,432	48,886
		$8,672,180		$375,070

[1/] Nutria 1.5 percent of state
Raccoon 7.5 percent of state
Mink 10.5 percent of state

Source: Louisiana Department of Wildlife and Fisheries as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin", F. W. Bell, 1981.

Section 6 - CONDITIONS IF NO FEDERAL ACTION TAKEN (WITHOUT CONDITION PROFILE)

A.6.1. Because of the devastating effects that would result from not controlling flows into the Atchafalaya Basin at the Old River control complex and from not providing flood overflow restraint with the basin protection levees, there is not a true no-action alternative for this study. The conditions described below reflect a 70-30 flow distribution of total latitude flow below Old River control complex, with 30 percent regulated to the Atchafalaya River, and assumed continued development and maintenance of the basin protection levees to project flood levels by local or state interest.

Environmental Setting and Natural Resources

GEOLOGY AND SOILS

A.6.2. The changes in the geology of the basin are dependent upon the natural overflow process of the river, river water sediment deposition, and riverine changes. For this reason any further change in existing geology and soils will parallel the changes described previously.

CLIMATE

A.6.3. Changes in climate are unrelated to the projected without-project conditions in the basin. Natural changes will continue, but averages should approximate the average climatic conditions described in the previous section.

SEDIMENTATION

A.6.4. The process of a river overflowing its banks and depositing sediments in the adjacent land areas is a natural developing process of a young (in geologic time) river such as the Atchafalaya. Each year as the river conveys spring floods to the gulf, it will overflow its banks and continue to deposit sediments in the flooded overbank areas.

A.6.5. Projections of river overflow sediment deposits in the overbank areas are shown by the area-elevation curves for each management unit area (see Appendix C). As the natural levees within the Atchafalaya Basin build up to higher elevations from the yearly overflows, the quantities of water diverted to the overbank areas would gradually decrease; and therefore, the quantities of sediment deposited, or rate of sediment deposition on the overbank areas, would be expected to decrease over time. While the most significant amounts of deposition have already taken place over most of the basin, additional sediment deposition of up to 9 feet could occur in some areas.

A.6.6. The most significant areas of sediment deposition above the Teche Ridge would be in the Grand and Sixmile Lake areas. These areas are in a region where the main channel has yet to completely form natural levees; therefore, the overbanks are subject to frequent overflows and up to 9 feet deposition could be expected. This building of the river banks in the area would eventually result in the main channel having confining natural levees throughout the Lower Atchafalaya Basin Floodway. The filling of the open water areas would continue and ultimately would result in a relatively narrow channel through Sixmile Lake to Wax Lake Outlet.

A.6.7. Sediment deposition to the east of the main channel would not be as great in the distant backswamps. For most of the Upper Belle River area, deposition of less than 2 feet is expected. This large area receives only about 16 percent of the total basin discharge, and the waters reaching the area would have already lost their heavy sediment load during the long distance traveled from the main channel. Because of the small amount of deposition expected, this area should generally maintain its present water regime.

A.6.8. Like the Sixmile Lake area, higher deposition rates are expected in the southern and western portions of Upper Belle River as the main channel builds its natural levees; but since the main channel in this region is losing flow to Wax Lake Outlet, the deposition could be expected to be no more than 5 feet and be confined to those lands within a mile of the main channel.

A.6.9. The area of Crevasse would be subjected to up to 7 feet of sediment. This high rate of deposition is expected because practically all of the unit is located within the actively building natural leveed portion of the main channel, and because a significantly large volume of water flows through Lake Chicot, Grand Lake and Willow Cove during floods.

A.6.10. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the west access channel and Lake Fausse Point Cut (15 percent of basin flow), Buffalo Cove is subject to

levee-building on both sides. Through the natural levee-building process which has already taken place, and the sediment disposal which was placed near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflows into Buffalo Cove on a regular basis. In addition, access channels, such as the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions would subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition.

A.6.11. The remaining hydrologic areas of the Lower Atchafalaya Basin Floodway are not subject to significant regular overflow patterns; therefore, expected deposition of sediment would be generally limited to the bank areas and be less than 5 feet. Exceptions to this general pattern are the Warner Lake and Alabama Bayou areas. Warner Lake is completely surrounded by high banks and only about one foot of additional deposition would be anticipated. Alabama Bayou is already well protected from main channel overflow by the east river levee. During times when the Morganza Floodway is not operated, it is subject only to overflow from backwater that has already passed through most of the Bayou des Glaises area. Thus, no additional sediment deposition would be expected in Alabama Bayou.

A.6.12. Sediment that passes through the Lower Atchafalaya Basin Floodway to the Atchafalaya Bay will continue to build the delta. As shown in Figure A-6-1, it is expected that about 300 square miles of land would emerge in this active deltaic process. If no action is taken to control flows through the Lower Atchafalaya River and Wax Lake Outlets, Wax Lake Outlet will capture a larger share of the flow to be conveyed to the gulf. For this reason, a westward shift in the delta-building process would take place, resulting in more land emerging near the mouth of Wax Lake Outlet.

HYDROLOGY

A.6.13. The cross-sectional area of the main Atchafalaya River channel, approximately above river mile 55, was in 1980 averaging about 118,000 square feet. The continued channel enlargement of this reach of the river would be minimal, with only about a 121,000 square-foot channel area expected by the year 2030. As the natural levees of the main channel in the Lower Atchafalaya Basin Floodway are built up, a larger percentage of the river flow will be confined to the channel, which will result in its continued natural enlargement. The channel's cross-sectional area between mile 54.8 and 65.4 is projected to increase from 92,000 square feet to about 110,000 square feet. Between mile 65.4 and mile 100.8, the channel cross section would increase from about 80,000 to 98,000 square feet.

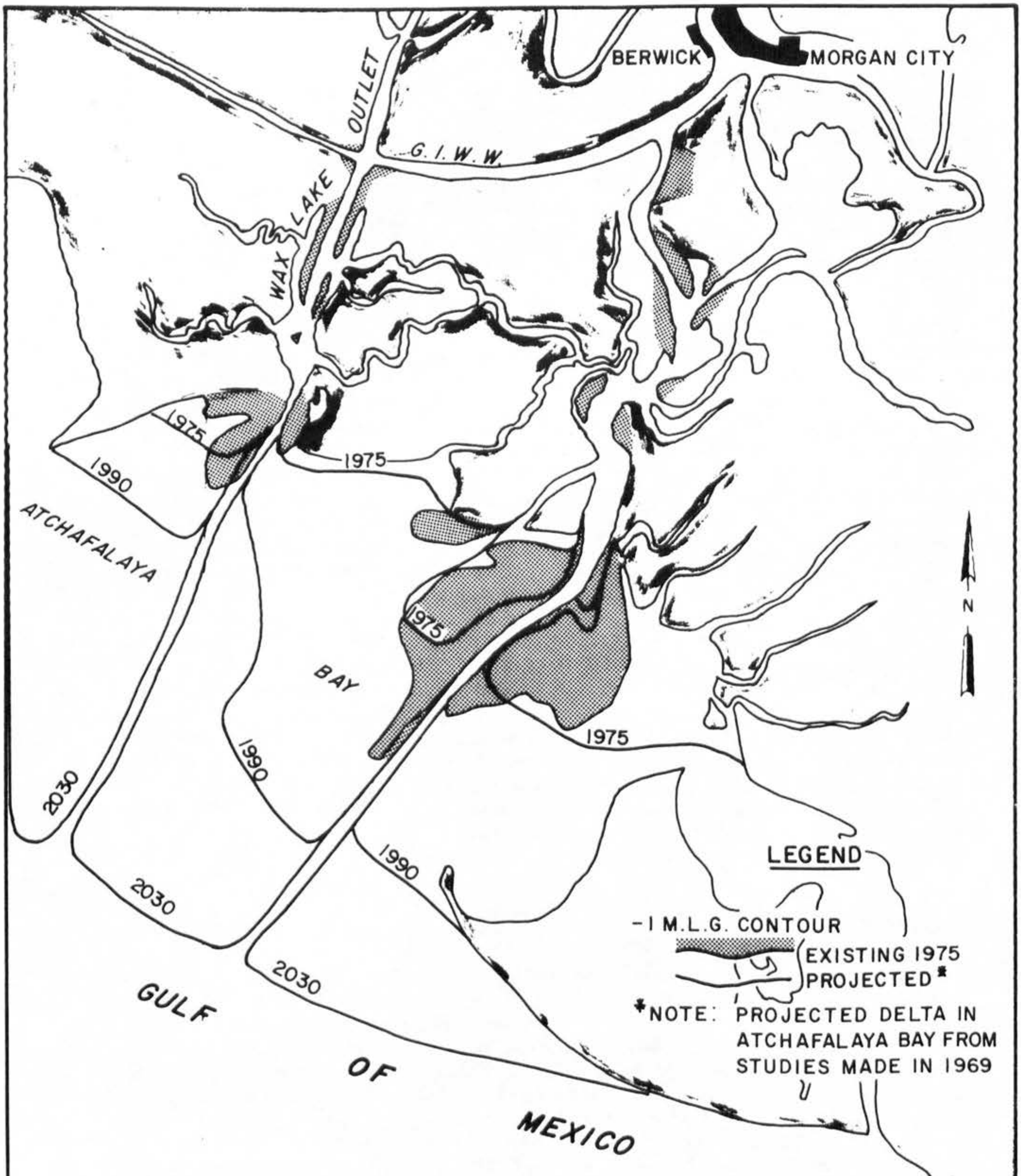


FIGURE A-6-1

PROJECTED AND EXISTING DELTAIC GROWTH

A.6.14. Wax Lake Outlet, with its gradient advantage over the Lower Atchafalaya River for flow to the gulf, will continue to convey an increasing percentage of the latitude flow. It is estimated that by 2030, approximately 50 percent of the latitude flow would be conveyed through the Wax Lake Outlet. Concurrent with this increasing flow, the cross-sectional area of Wax Lake Outlet will increase to about 51,000 square feet. Because of the concurrent decreases in flow, the main channel cross-section below river mile 100 would decrease in area. From mile 100.8 to mile 113.7 the area is projected to decrease in size from 38,000 square feet to about 17,000 square feet by 2030. The area of the Lower Atchafalaya River (mile 113.7 to 136.0) would decrease from 69,000 square feet to about 47,000 square feet.

A.6.15. This evident shift in the distribution of flow through the outlets, toward a larger part of the total flow being conveyed by Wax Lake Outlet, would have the effect of a loss in the total conveyance capacity of the outlets as exists in 1980. This, along with the projected overbank sediment deposition, would cause the project flood flowline to become higher than if some alternate action were taken. The no-action flowline is projected to be up to 1.5 feet higher than the 1973 refined flowline. This higher flowline effect extends along the East and West Atchafalaya Basin Protection Levee, Morganza Floodway levees, and the Atchafalaya River levees.

A.6.16. The no-action alternative or without-project condition affects the average stage hydrographs in the same manner as the project flood flowline. The peak stages expected for the average hydrograph would be higher for no-action than it would be if some preventive alternative actions are taken. The differences in magnitude are generally between 1 and 2 feet higher for all areas of the basin. This is shown in the average stage hydrographs for each management unit area (Plates C-28 through C-36 of Appendix C.)

A.6.17. As deltaic development of the Atchafalaya Bay continues, the mouth of the Atchafalaya River will continue to move gulfward, and stages at the end of the Avoca Island levee for a given discharge will continue to escalate. It is the stage at the end of this levee that governs the amount of backwater flooding that reaches the area northeast of Morgan City. For this reason, the backwater flooding problem in this area would continue to worsen with the no-action plan. The stage at Amelia, with the average return interval of 100 years, is expected to rise from 5.5 feet to 7.9 feet. Similar increases in stage are expected to occur throughout the backwater area.

Biological Resources

A.6.18. Vegetative associations and habitat types in the project area form a complex and continually changing pattern. The dynamic nature of this pattern is due to changes induced by varying water levels and hydroperiods, sediment deposition in open water and overbank areas, and changes in salinity. These naturally occurring processes are further altered by men who controls the flow at Old River, clears land for timber and agriculture, dredges canals, and builds levees.

A.6.19. As mentioned previously, the future without-project would include impacts caused by raising the existing levees associated with the project. This levee raising would be included in the without-project analysis because the basin is, first and foremost, a floodway and would probably continue to be maintained as such by local interests in the absence of a Federal project. Habitat changes which would be associated with this levee raising are shown in Table A-6-1.

TABLE A-6-1

HABITAT CHANGES THAT WOULD OCCUR DUE TO RAISING LEVEES IN THE PROJECT AREA TO MEET FUTURE WITHOUT-PROJECT FLOWLINE NEEDS FOR PROJECT FLOOD

Habitat Type	Acreage Gain or Loss
Late Successional Bottomland Hardwood	-8,215
Early Successional Bottomland Hardwood	-2,411
Cypress-Tupelo	-2,392
Cypress-Tupelo/Bottomland Hardwood Mix	-32
Open Land	+1,459
Fresh Marsh	-100
Bayous and Slow Canals	+11,691

A.6.20. The major change-producing processes in the basin are all interrelated and, acting together, they cause changes in habitat types. To evaluate these changes, the water levels, sedimentation rates, rates of land clearing, changes in salinity, etc., were projected into the future. Following consultation with a number of foresters, it was concluded that sediment deposition in the floodway would not adversely affect the bottomland hardwood habitat type. Due to the age of the early successional forests in the Henderson area, it was assumed that they would succeed to mid-successional hardwoods by 1990. However, when lowering of the water level and shortening of the hydroperiod would cause cypress-tupelo swamps to become flood-free three years out of five, from 1 June through 30 November, and it was assumed that they would succeed to a mix of cypress, tupelo, and bottomland hardwoods, such as ash and red maple, if they were not cleared for agriculture. When sedimentation or a combination of sedimentation and falling water levels was the cause of the swamp becoming flood-free, the area was assumed to succeed to a mix of cypress, tupelo, willow, and cottonwood. Occasionally, due to lack of knowledge of hydrology or stand age, or location of sediment deposition, it was necessary to assume that the swamp would convert to a forest of unknown category.

A.6.21. Following consultation with agricultural authorities, it was concluded that any lands flood-free, three out of five years from 1 June through 30 November, would be suitable to clear for agricultural use. Clearing was assumed to start in 1980 in the Henderson and Alabama Bayou areas, and in 1995 in the remainder of the basin except for the Upper Belle River and Sixmile Lake areas, which would be either too wet or impracticable to clear due to access problems, or which would be state-owned. It was further assumed that 80 percent of the lands suitable for clearing would be cleared during a 50-year period (past clearing trends in the West Atchafalaya Floodway indicate that the 80-percent figure is reasonable to use).

A.6.22. The cypress in the basin are nearing maturity and will soon be suitable for lumbering. It was assumed, after consultation with foresters familiar with logging operations in the area, as a worst case approximation, that 50 percent of the present cypress acreage would be cleared in increments of one percent per year during the next 50 years. It is difficult to project the eventual fate of such lands. If water levels drop or sedimentation occurs, some type of bottomland hardwood community would occur after clearing. If water levels increase, logged areas could convert to a marsh or open water habitat. If water levels remain near those at present, cypress could regenerate. In any case, tupelo, even if it were cut, would continue to grow in these areas because this species regenerates well from stump sprouts.

A.6.23. Table A-6-2 shows the expected changes in acreage of habitat types in those parts of the project area that would be affected by

CHANGES IN ACREAGE BY HABITAT TYPE
BETWEEN 1980 AND 2030 WITHOUT PROJECT

	Thousands of Acres		
	1980	2030	Gain or Loss
Early Successional Bottomland Hardwood	93.9	35.2	-58.7
Mid-to-Late Successional Bottomland Hardwood	332.0	186.1	-145.9
Cypress-Tupelo	451.0	415.0[1/]	-36.0
Bottomland Hardwood mixed with Cypress-Tupelo	8.4	20.2	+11.8
Composition Unknown	0	51.6	+51.6
Open Land	97.2	283.8	+186.6
Fresh Marsh	321.3	243.1	-78.2
Brackish Marsh	89.0	64.4	-24.6
Saline Marsh	107.3	67.3	-40.0
Delta	10.1	135.0	+124.9
Riverine and Distributaries	31.1	32.1	+1.0
Fresh Bayous and Canals	38.0	50.9	+12.9
Headwater Lakes	18.2	1.9	-16.3
Backwater Lakes	42.0	34.0	-8.0
Cropland Lakes	0.03	4.1	+9.07
Brackish Bayous and Canals	6.2	8.1	+1.9
Saline Bayous and Canals	6.1	7.4	+1.3
Fresh Marsh Ponds and Lakes	87.6	141.6	+54.0
Brackish Marsh Ponds and Lakes	55.2	75.3	+20.1
Saline Marsh Ponds and Lakes	64.4	99.0	+34.6
Fresh Bays	200.0	75.7	-124.3
Brackish Bays	58.9	58.9	0
Saline Bays	53.8	53.8	0
Shallow Gulf	804.0	804.0	0
Other	5.7	8.3	+2.6

[1/] One-half of this would be cut-over.

proposed project features during the next 50 years, if the project is not implemented. A brief discussion of the expected changes that could occur within these habitat types follows.

Terrestrial Resources

EARLY SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.6.24. The acreage of this forest type would decrease by about 59,000 acres or 60 percent (Table A-6-2). About half of this decrease would be due to the conversion of the existing 25,000 acres of old growth of this type within the Henderson area, to the mid-to-late successional bottomland hardwood category, or to clearing of these areas for agriculture. By 2030, much of the remaining 35,000 acres of early successional forest would have reached the mature stage and would contain a well-developed understory and ground cover. Thus it would be of moderate value to wildlife. Additionally, sedimentation within the lakes of the lower basin would cause the formation of some 20,000 acres of land. Much of this would probably become vegetated with the early successional forest type although the exact fate of such lands cannot be predicted with certainty. (For this reason, the forests forming on these accretion lands were assigned to the forested unknown category at the insistence of the EPA). Overall, the net change in the early successional forest acreage would be negative.

LATE SUCCESSIONAL BOTTOMLAND HARDWOOD FORESTS

A.6.25. The acreage of this forest type would decrease by about 146,000 acres or 44 percent (Table A-6-2). This loss would be caused mainly by land clearing for agriculture. Much of the acreage remaining in 2030 within the lower floodway would be more mature and would contain a greater proportion of oak and sweetgum than it does today and would also contain more groundcover due to the shortening of hydroperiods that will occur as the Atchafalaya River matures. The changes would make these forests have a higher carrying capacity for many species of wildlife than is the case today, although this increase in carrying capacity would not make up for the loss in total acreage. In the backwater area northeast of Morgan City, however, rising water levels and increased duration of flooding would cause continued mortality to some stands of nonwater tolerant tree species and their replacement with some more water tolerant forms, such as bitter pecan and overcup oak. A corresponding decrease in the value of the habitat for certain terrestrial species of wildlife would, therefore, ensue.

CYPRESS-TUPELO SWAMPS

A.6.26. The overall decrease in cypress-tupelo acreage by the year 2030 would be about 36,000 acres (Table A-6-2). Most of this decrease would occur due to a conversion of this forest type to the bottomland hardwood mixed with cypress-tupelo category (see Table A-6-2), which would occur due to sedimentation and a lowering of water levels within the Lower Atchafalaya Floodway. A factor of far greater importance to the ecology of the basin than this loss of cypress-tupelo would be the harvest of these areas for timber. For a worst-case analysis, it was assumed that 50 percent of the acreage existing in 1980 would be cut-over by the year 2030. Thus, by 2030, half of the acreage of both cypress-tupelo and cypress-tupelo mixed with bottomland hardwoods would be harvested. These harvested areas might ultimately have either a higher or lower value as fish and wildlife habitat following logging, depending upon the successional pattern that develops. However, the initial effect of logging would be to lower the value of these areas, and recovery of former potential value might be slow. Rising water levels in the backwater area northeast of Morgan City could also have a detrimental effect upon the cypress-tupelo forests located there by causing slowed growth and reduced regeneration.

COMPOSITION UNKNOWN FORESTS

A.6.27. The acreage in the composition unknown category would increase from zero in 1980 to about 52,000 acres in 2030 (Table A-6-2). Approximately 20,000 of these acres would probably be early successional bottomland hardwoods that invade as the headwater and backwater lakes are filled by sedimentation. The remainder would be swamp mixed with either early successional or late successional bottomland hardwoods.

A.6.28. The value of these areas for wildlife would be directly dependent upon the age of the stand occurring on the accretion areas or the swamps; and therefore, the overall value of this habitat type should tend to increase with time.

OPEN LAND

A.6.29. The acreage of open land in the affected area would increase from about 97,000 acres in 1980 to 284,000 acres in 2030 (Table A-6-2). This is about a threefold increase and it would occur almost entirely as a result of the clearing of bottomland hardwood forests for conversion to agricultural land. The overall effect of this land conversion would be to greatly decrease the carrying capacity of the

affected areas for wildlife. Aquatic resources would also suffer from the loss of these periodically flooded forests in terms of reduced productivity.

MARSH AND DELTA

A.6.30. As can be seen from Table A-6-2, changes in marsh and related aquatic habitat types will be dynamic over the next 50 years. Fresh marsh would decrease from 321,000 acres in 1980 to 243,000 acres, a loss of 24 percent. Brackish marsh would decrease by 28 percent from 89,000 acres to 64,000 acres. At the same time, saline marsh would decrease from 107,000 acres to 69,000 acres, a loss of about half the existing saline marsh. As the Atchafalaya Bay delta grows from 10,100 acres today to 135,000 acres in 2030, most of the newly created land would become fresh marsh. Thus, on the balance at the end of project life there would be about 47,000 acres more fresh marsh, 24,500 acres less brackish marsh, and 38,000 less acres saline marsh than in 1980.

A.6.31. Marsh Loss and Gain. Marsh loss occurs for a variety of reasons: inner marsh deterioration, shoreline and bank erosion, dredging and filling activities, subsidence, and confinement of Mississippi River flows. A major cause of future marsh loss in the project area would be the reduction in river borne sediment transport to the western Terrebonne Parish marshes. This would occur because the developing delta would progressively reduce the cross-sectional area of the bayou mouths, such as Deer Island, Palmetto, and Carencro, thereby, decreasing the amount of sediment which reaches the marshes via these bayous. Thus, as time goes on, the loss rate in the Terrebonne marshes would continue to increase. The eastern Terrebonne marshes would not be influenced by this effect, and the loss rates there would remain as they are at present. In order to delineate what habitat type this marsh would become, preliminary raw data from the Wicker (1980) study was used. The study indicates that the majority of the deteriorating marsh becomes ponds.

A.6.32. Low flow salinity conditions are one of the most important factors used to determine marsh vegetative types. At the present time, the distribution of flow from the lower floodway is 70 percent Lower Atchafalaya River - 30 percent Wax Lake Outlet. In the future without-project, nearly 50 percent of the flow is expected to pass through the Wax Lake Outlet. It is almost impossible to quantify the changes in marsh-habitat type that would occur in the future because of the westward shift of the flow distribution. It is probable that some fresh marsh, especially in the area just east of Four League Bay, would become brackish. Some saline marsh near Point au Fer would probably become brackish, but in most of the project area the acreage

of saline marsh would expand northward. Because of the difficulty in predicting such changes, the 1980 boundaries of marsh-habitat types were assumed not to change over the project life. Loss rates were then projected within each habitat type to calculate the 2030 marsh acreage.

A.6.33. Water levels in the marshes would rise over project life during average river flows, but not enough to significantly impact marsh acreage. Levels in fresh marshes would rise slightly over one foot, in brackish marshes approximately one foot, and in saline marshes less than one foot. This additional water would carry sediments and nutrients and this could balance the adverse physical impacts of flooding. For a 100 year flood, water levels in the marsh would rise significantly. The impacts of such a rise are difficult to estimate. Extensive permanent ponding could occur as the flood receded or ponds could be reclaimed by marsh plants in 3-10 years.

A.6.34. Adams and Bauman (1980) have predicted that most of Atchafalaya Bay will have been converted to delta by 2010. Thus by 2030 under future without-project conditions, 135,000 acres of delta would exist and the acreage would have increased at the expense of fresh bay. See Appendix G for further details on the methodology for calculating marsh and delta acreages.

Aquatic Resources

RIVER AND DISTRIBUTARIES

A.6.35. The amount of this habitat in the project area was assumed to increase slightly throughout the life of the project, due to bank erosion.

HEADWATER LAKES

A.6.36. Headwater lakes would decrease drastically from 18,200 acres in 1980 to only 1,900 acres in 2030 (Table A-6-2). The quality of the remaining lakes would be poorer than at present because of the increased agricultural runoff from the extensive land clearing that is expected to occur in the basin. As these lakes fill in, most would probably become early successional bottomland hardwoods. Some would remain aquatic habitat but become reclassified as cropland lakes. The loss of this headwater lake habitat would drastically impact fisheries production because these lakes are prime habitat for sport fish and crawfish. Zooplankton population cycles could be changed because

headwater lakes act as reservoirs from which many zooplankton species are washed out into other habitats.

BACKWATER LAKES

A.6.37. In the project area, the acreage of backwater lakes would decrease from 42,000 acres in 1980 to 34,000 acres in 2030 (Table A-6-2). However, the entire decrease would be due to sedimentation in the Lower Atchafalaya Floodway where acreage would decrease from 13,800 acres to 5,000 acres. Again, the majority of these filled lakes would probably become early successional bottomland hardwoods while some would be classified as cropland lakes. Water quality in backwater lakes in the floodway would be poorer in 2030 than at present due to the extensive agricultural development that would occur in the basin; however, backwater lakes northeast of Morgan City would not be so affected because agricultural encroachment would not occur.

CROPLAND LAKES

A.6.38. Cropland lakes would increase from 30 acres in 1980 to 4,100 acres by 2030 (Table A-6-2). This increase would not represent new lakes, instead lakes presently classified as headwater or backwater lakes would be classified as cropland once they were surrounded by agricultural lands. These reclassified lakes would not be as productive as in 1980; however, they would still support fish such as shad and carp. It is possible that fish from such lakes could be heavily contaminated with pesticides.

BAYOUS AND CANALS

A.6.39. Fresh bayous and canals would increase from 38,000 acres in 1980 to 50,900 acres in 2030 (Table A-6-2). Approximately 7,300 acres of this entire increase would be due to direct construction impacts of levee raising in the Lower Atchafalaya Basin Floodway and in the marshes south and west of Morgan City. This increase would provide valuable aquatic habitat because borrow pits, especially those on the floodside of the levees, are very productive in terms of fish and benthos. The remainder of the increase (5,600 acres) would occur as fresh marsh eroded. Brackish bayous and canals would increase from 6,200 acres in 1980 to 8,100 acres in 2030 (Table A-6-2) as brackish marshes eroded. Thus, the acreage of saline bayous and canals would increase from 6,100 acres in 1980 to 7,400 acres in 2030 due to erosion in saline marsh.

MARSH PONDS AND LAKES

A.6.40. Fresh marsh ponds and lakes would increase from 87,600 acres in 1980 to 141,600 acres in 2030 (Table A-6-2). As described earlier, this increase would come at the expense of fresh marsh. Brackish marsh ponds and lakes would increase from 55,200 acres in 1980 to 75,300 acres by 2030 (Table A-6-2). This increased acreage would come from deterioration of brackish marsh. Saline marsh ponds and lakes would increase from 64,400 acres to 99,000 acres while the saline marsh itself would decrease in acreage (Table A-6-2). Thus in summary, marsh ponds and lakes would increase by 50 percent from 207,200 acres to 315,900 acres. The total loss of marsh over the project life would be 140,800 acres. Ponds and lakes are valuable for fishery resources, but the lost marsh is even more vital. Marsh plants are the source of detritus that is the basis of the estuarine ecosystem in south-central Louisiana. Phytoplankton is also important in driving this ecosystem, but a square meter of pond will have a net primary production of only about 600 grams of dry weight per year (Day et al., 1973). A square meter of marsh will have a net production of approximately 2,200 grams of dry weight per year (Gosselink et al., 1977). The dramatic increase in ponds and lakes would provide habitat for fish, shellfish, and plankton but do little toward producing food to sustain them.

BAYS AND GULF

A.6.41. Brackish bays, saline bays, and shallow gulf would have the same acreage in the area in 2030 as they do in 1980 (Table A-6-2). Fresh bays would decrease from 200,000 acres in 1980 to 75,700 acres in 2030 (Table A-6-2). The land lost from Atchafalaya Bay would become delta as previously described. As the delta enlarges, salinities in the Cote Blanche-Vermilion Bay system would gradually decrease as more river water becomes available. Salinities in the Four League Bay-Lake Mechant-Caillou Lake system have been decreasing recently, and this trend is expected to continue over the project life.

Changes in Wildlife and Fisheries

CHANGES IN TERRESTRIAL WILDLIFE RESOURCES

A.6.42. The changes that would occur within the Atchafalaya Basin to terrestrial wildlife resources in the absence of a Federal project would be profound and significant. The loss of about 187,000 acres of forests and their conversion to open land used primarily for agriculture would be the major cause of this change, although the

changes in marshland acreages that would occur south of Morgan City would also be important. The most profound result of land use changes would be the reduction in population levels of forest-dependent animals. The fact that the basin is heavily utilized by migratory birds both as a breeding area and as a wintering area could cause these reductions in population levels to be felt far outside the study area, since the basin is the last remaining large-scale river swamp ecosystem in the Mississippi Valley. Loss of 187,000 acres of forest land could cause a continent-wide reduction in population levels of species that require the river swamp ecosystem to complete their life cycle. Other species that use the basin only temporarily during migration might be forced to alter their migration patterns or perhaps themselves become reduced in numbers.

A.6.43. To illustrate the magnitude of the changes that could occur to terrestrial wildlife resources, the theoretical estimated changes in the population levels of a group of representative species will be presented and discussed (Table A-6-3). These species are thought to be representative of a cross section of the terrestrial wildlife inhabiting all of the basin, and changes of a similar nature might be expected to affect other forms not discussed here.

TABLE A-6-3

ESTIMATED CHANGES IN THEORETICAL POPULATION LEVELS OF REPRESENTATIVE TERRESTRIAL SPECIES WITHIN THE ATCHAFALAYA BASIN SOUTH OF KROTZ SPRINGS[1/]

Species	1980 Population Level	2030 Population Level	Gain or Loss
Deer	12,400	10,700	-1,700
Swamp Rabbit	371,000	387,000	+16,000
Bear	50	None	-50
Wood Duck	15,000	14,000	-1,000
American Robin	453,000	295,000	-158,000
Clapper Rails	393,000	267,000	-126,400
Bobwhite Quail	15,000	34,000	+19,000
Mink	73,000	63,000	-10,000
Red-eyed Vireo	1,658,000	1,182,000	-476,000

[1/] Based on a survey of available literature and the personal knowledge of several biologists. These figures were calculated for comparative purposes only and do not necessarily represent actual population levels.

A.6.44. Deer. Deer populations would decrease by about 14 percent (Table A-6-3). Most of this decrease would take place within the Atchafalaya Floodway and would be due to conversion of forestland to agricultural land.

A.6.45. Swamp Rabbit. Swamp rabbit populations would probably increase by about 4 percent (Table A-6-3). The primary reason for this would be the increase in marsh acreage that would occur due to the growth of the Atchafalaya Delta. This increase in marshland would more than replace the population losses that would occur due to forestland conversion to farmland.

A.6.46. Bear. Bears are presently uncommon within the project area and occur primarily in the northern part of the basin. They would be eliminated due to the loss of forest habitat within the Atchafalaya Floodway System (Table A-6-3). Similar losses might be expected to occur to wild turkey populations, although it is possible that some turkeys might persist in the southern basin in the future.

A.6.47. Wood Duck. Resident wood duck populations would probably not decrease markedly (Table A-6-3). The greatest losses of these birds would occur in the bottomland hardwood areas that would be cleared for agriculture. However, an increase in the carrying capacity of cypress-tupelo swamps due to logging, which would tend to promote improved brood-rearing habitat, as well as stimulate the growth of emergent aquatics, would tend to offset these losses. It should be pointed out, however, that the overall impact of the future without-project condition on migratory wood duck populations would probably be more severe as the forested areas north of the project area, which are now used as wintering habitat by migrants, are cleared for agriculture. This forest removal would tend to make the remaining forested areas farther south even more important, and if these too are cleared, as would occur in the future without-project condition, then there might be too little wintering habitat in the future to support the existing migrant population in the Mississippi Valley.

A.6.48. American Robin. The American robin is an example of a songbird that uses the basin only as wintering habitat. Each winter thousands of these birds from distant points in the northern United States and Canada converge upon the area where they pass the colder months, then return north when spring arrives. Usage of the basin by these migrants would be drastically curtailed in the future and population levels could drop as much as 35 percent (Table A-6-3). The primary reason for this decrease would be the clearing of the late successional bottomland hardwood forests for agriculture.

A.6.49. Clapper Rail. Clapper rails are characteristic resident birds of brackish and saline marsh, and population levels could undergo as much as a 32 percent decline in the future. The reduction would be due almost entirely to the loss of about 65,000 acres of brackish and saline marsh.

A.6.50. Bobwhite Quail. Bobwhite quail, characteristic birds of farmlands, are presently uncommon within the project area due to the lack of suitable habitat. Quail population could increase as much as 126 percent (Table A-6-3) under the future without-project condition due to the expansion of agricultural activities within the basin. Similar increases in population levels of open land and forest edge species, such as mourning doves and cottontail rabbits, could be expected to occur also.

A.6.51. Mink. Mink are characteristic mammals of cypress-tupelo swamps and reach their highest population density there, but they also occur in the other habitat types of the project area. There could be as much as a 13 percent reduction in numbers of mink in the future (Table A-6-3). This would be due mainly to a loss of forestland due to agricultural conversion. Growth of the Atchafalaya delta would create some new mink habitat but not enough to offset these losses.

A.6.52. Red-eyed Vireo. The red-eyed vireo is an example of a migratory songbird that lives in the basin only during the breeding season. During the colder months, these birds live in South America. Like the American robin, these birds would be greatly affected by the future without-project condition. Population levels could decrease by as much as 29 percent (Table A-6-3) due to the conversion of forestland to agricultural land.

CHANGES IN FISHERY RESOURCES

A.6.53. The changes in fishery resources that would occur within the Lower Atchafalaya Basin and adjacent marshes in the absence of a Federal project would be dramatic.[1/] The most significant changes would be due to the conversion of 123,000 acres of annually flooded forested lands to agricultural lands. Other major impacts would be the net loss of 20,000 acres of lake habitat due to sedimentation and creation of 125,000 acres of delta. The major result of habitat losses would be a reduction in the harvest of freshwater fish and crawfish. To illustrate the magnitude of these losses, estimated reductions in harvest levels of some common species will be presented and discussed. Changes in the marsh-delta complex will be reflected in changes in harvest rates of estuarine dependent species.

A.6.54. As has been previously described, cypress-tupelo swamps, as well as early and late successional bottomland hardwoods function as

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[1/] Fishery losses in the backwater area northeast of Morgan City have not been calculated because of the lack of predictive data.

valuable aquatic habitat while they are flooded and also produce detritus that drives the aquatic food web. To estimate the impacts of the loss of this habitat, the amount of each habitat type flooded by the peak of the average shifted stage hydrograph was calculated for present conditions and for 2030. Harvest data were available for the Lower Atchafalaya Basin Floodway from National Marine Fisheries Service (NMFS) (Bell, 1981) and from the Atchafalaya Basin Usage Survey (Soileau et al., 1975). These data were utilized to determine the harvest in numbers or pounds per acre for 1980 and then the pounds per acre were reduced from 5 to 15 percent for 2030 due to predicted effects of increased turbidity and pesticides on overall productivity.

A.6.55. Crawfish. Crawfish harvest would drop by nearly 40 percent (Table A-6-4). Losses would occur in headwater lakes but the most dramatic decreases would happen because of loss of forested areas that are flooded each spring. Crawfish are heavily dependent on such areas.

TABLE A-6-4

ESTIMATED CHANGES IN HARVEST LEVELS OF
REPRESENTATIVE AQUATIC SPECIES
WITHIN THE ATCHAFALAYA BASIN FLOODWAY SOUTH OF KROTZ SPRINGS

Species	1980 Harvest	2030 Harvest	Gain or Loss
Crawfish	14,900,000 lbs	8,918,000 lbs	-5,982,000 lbs
Buffalo	1,100,000 lbs	756,000 lbs	-344,000 lbs
Catfish	2,185,000 lbs	1,384,000 lbs	-801,000 lbs
Largemouth bass	488,000 fish	296,000 fish	-192,000 fish
Sunfish	1,429,000 fish	858,000 fish	-571,000 fish
Penaeid shrimp	47,840,000 lbs	46,790,000 lbs	-1,050,000 lbs
Menhaden	173,240,000 lbs	170,000,000 lbs	-3,240,000 lbs

A.6.56. Buffalo. Buffalo harvest would decrease by approximately 30 percent (Table A-6-4). The heaviest losses would occur because of loss of forested habitat, especially swamps and headwater lakes. Since buffalo can withstand turbidity and pesticides better than other commercial fish, their numbers would decrease less than other species.

A.6.57. Catfish. The harvest of catfish would decline by approximately 37 percent (Table A-6-4). Again, the largest decrease in harvest would occur as wooded acres are cleared, but loss of headwater lakes would also be an important factor.

A.6.58. Largemouth Bass. The potential harvest would decrease by nearly 40 percent with major losses attributable to habitat loss in forests and headwater lakes (Table A-6-4). Losses would also occur as turbidity and pesticides levels increase as agriculture becomes common in the basin.

A.6.59. Bluegill/Warmouth/Redear Sunfish. Potential harvest of these sport fish would decline by 40 percent as the forested areas are cleared and headwater lakes become filled with sediment (Table A-6-4). Increased turbidity and pesticides would also contribute to this decrease.

A.6.60. Benthos of the Lower Atchafalaya Floodway. The numbers of benthic animals per acre of habitat type were obtained or extrapolated from Beck (1977). The estimated number of benthic organisms in 1980 is 3,200,000 million, while by 2030 the number would probably fall to 2,500,000 million, a decrease of 20 percent. Since these organisms are not common in wet bottomland hardwood forests, the major decreases would be due to sedimentation in swamps and headwater lakes, as well as to increase in pesticide and turbidity levels.

A.6.61. Estuarine Dependent Species of the Marshes and Bays. To estimate the change in harvest rates for estuarine-dependent organisms, the various estuarine habitat types were weighed as to their contribution to the production of penaeid shrimp and menhaden. The number of pounds harvested in the project area was gathered from NMFS data for 1963-73 in Hydrologic Units 6 and 7 (US Army Corps of Engineers, 1977) and from NMFS data for 1963-78 in Hydrologic Unit 5. To accurately assess the poundage of shrimp harvested, the inshore catch was increased threefold to account for unreported sport and commercial harvest.

A.6.62. Shrimp. The harvest of shrimp is estimated to drop slightly from the 1980 level (Table A-6-4). Decreases would occur in the harvest attributable to marsh and fresh bays, while the increases in harvest attributable to ponds, bayous, and delta marsh would nearly compensate for the loss.

A.6.63. Menhaden. Menhaden harvest is expected to decrease slightly (Table A-6-4). Again, losses would occur in harvest attributable to marshes and fresh bays, but increases would occur in all types of ponds and lakes, bayous, and delta marsh.

A.6.64. Endangered Species. Of the 14 endangered and two threatened species that are believed to occur or possibly occur within the

project area, three could be adversely and significantly affected under the future without-project condition. These are the ivory-billed woodpecker, Bachman's warbler, and the Florida panther. Loss of forestland in the northern parts of the project area would be the primary reason for this happening. In all probability, the ivory-billed woodpecker and Bachman's warbler would disappear entirely (Bachman's warbler may already be absent) and panther would become reduced in numbers in the areas north of Morgan City. Additionally, the expansion of agricultural activity in the northern basin would cause increased water pollution due to pesticides, and this could adversely affect other species such as the peregrine falcon, the bald eagle, and the brown pelican, all of which are particularly sensitive to this form of environmental stress.

A.6.65. Timber Resources. Loss of 187,000 acres of hardwood forestland due to conversion to farmland would greatly deplete the hardwood timber resources of the project area. Additionally, existing and future alterations in the hydrology of the lower floodway could make regeneration of the now existing cypress-tupelo forest difficult. Since these forests are approaching harvestable age and will probably be cut in the near future, this resource might be permanently lost if regeneration is in fact prevented by the altered hydrology of these areas.

A.6.66. Agricultural Resources. Under future without-project conditions, there would be an expansion of agriculture as the forestland areas are cleared. A net gain of about 187,000 acres of farmland would result primarily due to forestland conversion within the Atchafalaya Floodway system. It should be pointed out also, that about 7,000 acres of existing row-crop agricultural land in the backwater area northeast of Morgan City could go out of production due to rising water levels associated with the rise in flowline being created by delta development.

Cultural Resources

ARCHEOLOGICAL RESOURCES

A.6.67. If present conditions continue in the Atchafalaya Basin, there would be no direct benefit to archeological sites. Obscuration of archeological sites by sedimentation will continue. Mound sites reported by C. B. Moore in 1913, and reported to have been between 3 and 6 meters high, have virtually disappeared. The number of smaller and lower sites, masked in this manner, is inestimable, and if allowed to proceed will render site discovery and study more difficult.

A.6.68. Unregulated development would have detrimental effects on archeological sites. Canal dredging for oil operations will adversely impact sites. The clearing of land for lumber or in preparation for agriculture is destructive to sites by direct impact and indirectly through the increase of erosion.

A.6.69. Use of lands as agricultural fields further disrupts even fairly deeply buried sites because of plowing and the changes in the capillarity, percolation, and leaching of soils. If the Atchafalaya River main channel meanders or if there are shifts in its tributaries-distributaries, then archeological sites in those deposits will be destroyed. The general lack of archeological sites along the present channel attests to the channel's dynamic recent history.

A.6.70. The ongoing enlargement of the Atchafalaya Basin protection levees will adversely impact numerous cultural resources located in borrow areas and in the levee rights-of-way. The cultural resources survey conducted by University of Southwestern Louisiana of the levee construction areas identified numerous resources possibly eligible for inclusion in the National Register of Historic Places.

A.6.71. With no restrictions on activities in the basin, in all likelihood archeological sites would be mined for their shell deposits and indiscriminantly looted by pothunters.

HISTORIC RESOURCES

A.6.72. The effects listed for archeological sites hold for historic sites with the exception that standing historic structures are largely located within established communities and would be more subject to industrial site development impacts.

A.6.73. As the Atchafalaya River continues to become wider and deeper under the influence of the natural forces of erosion and scouring, any subsurface or underwater historic ship remains in the river would be adversely affected.

FOLK CULTURE

A.6.74. Under the without-project conditions, the continuing sedimentation and draining of the swamps would adversely impact the extractive economy base, and thus, the life style of the folk who live on the edges of the floodway. The deterioration of the economic resource base would have far-reaching effects upon folk culture.

A.6.75. Few people presently live in the floodway since the trend has been a movement to the margins of the basin where employment opportunities have increased. It is expected that this trend will continue and thus the amelioration of the isolation of Atchafalaya folk culture, and the former within-the-floodway settlement pattern would continue.

NATIONAL REGISTER PROPERTIES

A.6.76. Only two sites located within the Atchafalaya Basin Floodway have been determined eligible for inclusion in the National Register. The Avoca Island Pumping Plant Number 1, 16SMY52, has been avoided by the project and a determination of no effect has been executed. Any effects on the Nutgrass Site, 16SM45, and other possibly significant sites identified by the cultural resources survey, due to the enlargement of the Atchafalaya Basin protection levees, will have to be addressed in accordance with ER 1105-2-460 and 36 CFR, Part 800.

NATIONAL TRUST PROPERTIES

A.6.77. Under the without-project conditions, the only National Trust property near the study area, Shadows-on-the-Teche, would not be affected.

Population Characteristics

A.6.78. Projected population trends for the Atchafalaya Basin area by parish are presented in Table A-6-5. Only five of the 19 parishes in the area show any growth. The declining population in the remaining parishes is a result of the net out migration among young adults discussed in Section 5. For the area as a whole, population growth of about 0.4 percent compounded annually over the 1980-2030 period is projected. Other population characteristics are more difficult to forecast, although trends over the period 1980-2030 can be qualitatively described. During this period, it is expected that the median age of the population in the area would rise slightly, as would educational achievement levels.

TABLE A-6-5

POPULATION PROJECTIONS FOR PARISHES IN ATCHAFALAYA BASIN AREA

Parish	1980	1990	2000	2010	2020	2030
Assumption[1/]	21,800	24,400	29,900	34,800	39,400	44,600
Avoyelles	37,900	38,100	37,500	36,800	36,200	36,200
Caldwell	9,400	9,400	9,300	9,100	9,000	9,000
Catahoula	11,800	11,900	11,700	11,500	11,300	11,300
Concordia	22,600	21,900	20,500	19,500	18,500	18,500
Franklin	24,000	23,200	21,800	20,700	19,600	19,600
Iberia	52,300	51,600	49,200	48,000	46,300	46,300
Iberville[1/]	31,700	32,800	33,800	34,700	35,600	36,500
Lafourche[1/]	81,300	95,200	122,500	147,700	171,200	198,400
LaSalle	13,300	13,400	13,200	13,000	12,800	12,800
Ouachita	128,600	139,600	146,100	149,700	153,200	156,800
Pointe Coupee[1/]	21,100	20,000	18,900	17,800	16,900	16,900
Richland	21,800	21,100	19,800	18,800	17,800	17,800
St. Landry	73,200	72,200	58,900	66,900	64,800	64,800
St. Martin	29,600	29,100	27,800	27,000	26,200	26,000
St. Mary	55,300	54,600	52,100	50,600	49,000	49,000
Tensas	9,700	9,400	9,100	8,900	8,800	8,800
Terrebonne	81,700	87,600	91,300	94,300	96,300	98,300
West Baton Rouge	19,300	21,900	24,000	25,800	27,000	28,300
TOTAL	727,100	755,500	783,400	809,800	832,900	900,100

[1/]These parishes are also included within the New Orleans to Baton Rouge Metropolitan Area (NOBRMA) Study Area, and the projections shown above for these parishes were derived for that study. All other projections were based on the source listed below.

Source: US Army Corps of Engineers, based on "1972 OBERS Projections of Regional Economic Activity in the United Stated--Series E Population", US Water Resources Council, and the Series E demographic projections of the Bureau of the Census.

MAJOR SKILLS AND OCCUPATIONS

A.6.79. The 1972 OBERS projections do not include employment forecasts by skill or industry groupings, but the growth of employment in different skill/industry classifications may be inferred by examination of the OBERS forecasts of industrial earnings growth in the study region. For Bureau of Economic Analysis (BEA) Economic Area 139, Lake Charles, Louisiana, which includes a large portion of the study region and is the BEA's most representative of employment opportunities available to residents, Table A-6-6 presents the most significant growth of industries.

TABLE A-6-6

SIGNIFICANT INDUSTRIAL GROUPS IN THE STUDY AREA (BASED ON PRESENT AND PROJECTED EARNINGS GROWTH IN BEA ECONOMIC AREA 139, LAKE CHARLES, LOUISIANA

INDUSTRY	1980 TO 2020 GROWTH FACTOR (PERCENT)
Wholesale and Retail Trade	156
State and Local Government	261
Crude Petroleum and Natural Gas (Exploration and Production)	53
Petro-Chemicals (Manufacturing)	230

A.6.80. The four industries listed in Table A-6-6 represent 42 percent of the total earnings in BEA Area 139 in 1980. The weighted growth factor in these four industries for the period 1980-2020 is 176 percent. The weighted growth factor for all industries in BEA 139 during the same period is forecast to be 194 percent. As a result, the share of these four industries, as measured by growth of earnings, in the total BEA economy would slip to 40 percent. In summary, these

four industries represent the most significant employment opportunities for residents of the Atchafalaya Basin area and will continue to do so for several decades.

EDUCATION

A.6.81. The average median number of school years completed among persons 25 years and over for parishes in the study area is expected to increase only slightly in the near future and remain below the average for both Louisiana and the nation.

RURAL AND AGRICULTURAL DEVELOPMENT

A.6.82. The most significant agricultural development in the area during the next several decades, in the absence of government action, would be the conversion of forestland to agricultural production. In the Lower Atchafalaya Basin Floodway, conversion of almost 200,000 acres of forestland is to agricultural land would be expected to occur. Table A-6-7 shows by decade the projected land clearing in the floodway. In the backwater area northeast of Morgan City no conversion of forestland to agricultural production is projected.

TABLE A-6-7

PROJECTED LAND CLEARING IN THE
LOWER ATCHAFALAYA BASIN FLOODWAY
(ACRES)

Year	Agricultural Land	Increment
1980	15,200	
		+13,000
1990	28,200	
		+54,500
2000	82,700	
		+70,300
2010	153,000	
		+33,000
2020	186,000	
		+16,000
2030	202,000	

A.6.83. The land clearing projected for these areas is a continuation of a process that has been ongoing in the lower Mississippi Valley for decades. The motivation for this changing land use is economic. From a monetary standpoint, the best use of the land, once it becomes relatively flood free, is soybean production.

A.6.84. According to crop budget data for soybean production, developed by Louisiana State University, the typical acre of land used to grow soybeans in the Atchafalaya Basin would generate net returns of approximately $75 per acre. Alternatives to soybean production, such as forestry and recreation, do not on average yield more than $20 per acre. The excess of the agricultural returns over the fees earned from alternative uses would average $55 per acre. The present value of an annuity of $55 per year for 100 years at 7-5/8 percent is approximately equal to $720. Given an initial conversion cost for land clearing and preparation of approximately $350 per acre, it is apparent that the profit-maximizing landowner will convert his land from forest to soybean production. (This condition is unadjusted for occasional flooding. Assuming an entire crop is lost, an average of one out of every five years, the average yearly return per acre is approximately $60. Accordingly, the excess of returns over alternative fees would be $40 per acre. The present value of this $40 annuity for 100 years at 7-5/8 percent would be approximately equal to $525.) Aside from the significant boost in demand for agriculture-related goods and services that this land use conversion would entail, the major impacts would be a reduction in forestry activities and recreational opportunities on the converted land.

A.6.85. In the absence of Government action, a further impact to agricultural lands will occur. As a result of rising water levels in the backwater area, approximately 10,000 acres of existing row-crop agricultural land would be forced out of production. This loss would occur primarily in the southern portion of the backwater area where stage increases would be the most dramatic. It should be noted that because protection, in the form of small levees and pumps, would be feasible for some acres, the actual loss would be less than the estimated potential 10,000 acres, which represents the worst-case situation.

A.6.86. Rural economic activity in the study area would be expected to expand with the development of water-based business activity in the upper portion of the lower floodway as part of the without-project condition. South of Krotz Springs, the higher lands adjacent to or in proximity to the main channel of the Atchafalaya River would be well suited for development by industry, which would require water access for transportation.

A.6.87. A significant factor to rural development in the study area would be the large number of structures, mostly camps and some permanent residences, that would be adversely affected by raising the

levees that comprise the Atchafalaya Basin Floodway system. This levee raising, which is required primarily due to subsidence, is viewed for purposes of this study as part of the without-project or no-action condition. To date, approximately 63 structures have been affected by levee raising already performed. Additionally, it is estimated that approximately 770 structures would be impacted by the remaining required work. Of the 770 structures, over 95 percent are located along the West Atchafalaya Basin Protection Levee.

A.6.88. An additional impact for many residents residing near the urban center of Morgan City would be the increased flood hazard resulting from increased backwater stages. In general, all residents of the backwater area northeast of Morgan City would be faced with rising stages if no Government action is taken. The largest number of these affected residents, however, would be located near the eastern edge of Morgan City. Table A-6-8 shows the total number of backwater

TABLE A-6-8

BACKWATER AREA POPULATION INUNDATED
BY SELECTED FREQUENCY EVENTS,
EXISTING AND FUTURE WITHOUT CONDITIONS

Existing Conditions (1980)	
Event Frequency (Years)	Population
5	100
10	100
25	100
50	1,300
75	2,500
100	3,400
Without Condition (2030)	
Event Frequency (Years)	Population [1/]
5	3,400
10	3,600
25	14,800
50	15,100
75	15,100
100	16,400

[1/] Affected population in 2030 is based on the existing population level.

area residents inundated by various frequency events for existing (1980) and future (2030) conditions, assuming no response by area residents to the increased flood hazard. This table shows that there would be significant increases in the number of inundated residents at all frequencies. For the higher frequency events, the area near Morgan City constitutes more than half of this affected population.

URBAN DEVELOPMENT

A.6.89. Growth in the urban centers, listed in Section 5, is expected to occur as population shifts from the rural areas of the area parishes to the urban centers. The continued importance of the wholesale and retail trade, petro-chemical processing, oil and gas exploration and production, and manufacturing serve to stimulate the growth of the urban centers.

EMPLOYMENT AND INCOME

A.6.90. As described in Section 5, the study area has consistently ranked lower than Louisiana in per capita personal income since 1950. Since no non-SMSA parish projections for personal income exist, US Department of Commerce, Bureau of Economic Analysis non-SMSA portions of Water Resource Subareas will be used instead of parish level projections. Water Resource Subareas (WRSA) 0807, 0808, and 0809 include a large portion of the Atchafalaya Basin Study area and will be used to demonstrate the trends in per capita personal income for the study area. Table A-6-9 presents these projections. While per capita personal income for all three WRSA's shows gains relative to that of the nation, they still lag behind state per capita income.

A.6.91. Table A-6-10 presents projections of total employment and employment/population ratios for the above-mentioned WRSA's, as well as for the entire state. As discussed in Section 5, the study area unemployment rate has been slightly higher than the statewide figure. The employment and employment/population ratios shown in Table A-6-10 suggest that this condition would not change significantly in the foreseeable future.

TRANSPORTATION

A.6.92. The most important development in the area's transportation network will be a north-south interstate highway to be constructed during the mid-1980's, linking Lafayette, Alexandria, and north Louisiana cities. This new transportation artery would stimulate

TABLE A-6-9

RELATIVE PER CAPITA INCOME PROJECTIONS

	1980	1990	2000	2010	2020	2030
Per Capita Income Relative (US = 100)						
Non-SMSA portion WRSA 0807	0.63	0.66	0.70	0.73	0.77	0.81
Non-SMSA portion WRSA 0808	0.68	0.70	0.72	0.75	0.78	0.81
Non-SMSA portion WRSA 0809	0.73	0.75	0.78	0.80	0.83	0.86
Louisiana	0.79	0.81	0.83	0.85	0.88	0.91

Source: US Department of Commerce, Bureau of Economic Analysis, "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, Non-SMSA Portions of Water Resources Subareas" and "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, States."

TABLE A-6-10

PROJECTIONS OF TOTAL EMPLOYMENT

1980	1990	2000	2010	2020	2030	
Non-SMSA Portion WRSA 0807						
Total Employment	85,600	92,000	99,200	101,300	103,500	105,700
Employment/population ratio	.32	.33	.35	.36	.37	.38
Non-SMSA Portion WRSA 0808						
Total Employment	160,700	160,900	161,500	159,100	156,700	156,700
Employment/population ratio	.36	.36	.38	.39	.39	.39
Non-SMSA Portion WRSA 0809						
Total Employment	95,300	105,200	116,400	122,100	128,000	134,200
Employment/population ratio	.34	.35	.37	.38	.38	.39
Louisiana						
Total Employment	1,379,800	1,477,800	1,589,700	1,634,900	1,681,300	1,729,100
Employment/population ratio	.37	.38	.40	.40	.41	.42

Source: US Department of Commerce, Bureau of Economic Analysis, "1972 OBERS Projections of Regional Economic Activity in the U.S.--Series E Population, Non-SMSA Portions of Water Resources Subareas" and "1972 OBERS Projections of Regionial Economic Activity in the U.S.--Series E Population, States."

development in the urban centers of Lafayette and Alexandria and may also improve employment opportunities for residents of the area who live near the new interstate highway.

OIL, GAS, AND MINERALS

A.6.93. No known long-term projections specific to the Atchafalaya Basin are available. This area is an important producing region for oil and natural gas and this is expected to continue in the forseeable future.

TIMBER

A.6.94. As discussed in Rural and Agricultural Development, the projected land use conversion in the Lower Atchafalaya Basin Floodway would significantly affect the forestry industry. Table A-6-11 shows the loss of late successional bottomland hardwoods by decade for the basin. The loss of these lands due to the conversion to agriculture will be substantial, amounting to approximately 137,000 acres.

PARKS AND RECREATION

A.6.95. The future without-project alternative with its resulting physical and biological impacts on the Lower Atchafalaya Basin Floodway will directly affect recreation.

A.6.96. The central channel of the basin would continue to become wider and deeper under the influence of the natural forces of erosion and scouring. As a result, large-scale changes in the land and water configurations of the floodway would occur. The self-enlarging of the river channel would increase its carrying capacity, thus leading to a draining of the swamps. Open water would convert to land and low land would become lands of higher elevation. Vegetative cover would change on these lands through natural succession. These changes in land and water patterns, occurring over time, would impact future land and water-based recreational activities.

A.6.97. Land use projections indicate that under the without-project conditions, as much as 44 percent of the mid-to-late successional bottomland hardwoods alone, or 146,000 acres, would be cleared and converted into agricultural land suitable for planting crops. Land conversion would have an adverse impact on big game and most forms of small game hunting, since both activities occur predominantly in areas

TABLE A-6-11

LATE SUCCESSIONAL BOTTOMLAND HARDWOODS IN
THE LOWER ATCHAFALAYA BASIN FLOODWAY
(ACRES)

Year	Total	Increment
1980	247,000	
		+ 10,000
1990	257,000	
		- 53,000
2000	204,000	
		-59,000
2010	145,000	
		- 24,000
2020	121,000	
		- 11,000
2030	110,000	

of bottomland hardwoods, the prime habitat for deer, turkey, and squirrel. A total of 55,500 user days of hunting supply would be lost annually by the year 2030 under the without-project conditions as a result of extensive land conversion. If this trend persists, at least an additional 25,000 acres would be cleared by 2080 resulting in an additional loss of 9,500 annual recreation user days. Other land-based activities occurring in the floodway, such as birdwatching, nature walking, hiking, and primitive camping, although nonquantifiable, would be adversely affected with the loss of vegetative cover that supports such activities. As a result, an overall loss in existing and potential recreational use would be realized. Future use would more heavily impact remaining lands because of projected higher user concentrations.

A.6.98. The quantity and quality of the recreational experience would be negatively impacted as more and more users compete for the remaining yet shrinking resources. In many instances, the recreational potential for a particular recreational activity would be completely displaced or lost as a result of land conversion. Lands that are now being leased by hunting clubs, but which would be replaced by soybean fields because of future greater economic returns, is a prime example of a lost resource.

A.6.99. As the swamps drain and bottomland hardwoods are cleared, water regimes and water quality would be adversely

impacted by sedimentation, accretion, and pollution from agricultural runoff. The diminution and degradation of total water acreage would result in an overall decrease in the amount of quality water-based recreation available. Most of the loss in terms of water acreage would occur in headwater and backwater lake areas. A loss of 24,300 total surface acres overall is projected for the lake aquatic habitat types over the project life under the without-project conditions. Generally, these are the areas most heavily used for fishing, boating, and canoeing. Although this acreage loss would not preclude any future use based upon boat-launching access and an overall available surplus acreage of water resources, it would, however, decrease the potential for a quality outdoor experience while concentrating future usage into the remaining acres.

A.6.100. Mineral extraction in the basin floodway would continue under the without-project conditions and under all other plan alternatives. Canals and pipelines would continue to be constructed, interrupting the natural esthetics of the basin floodway to a greater degree than that of the present.

A.6.101. The tendency for a greater percentage (from 30 to 50 percent) of the total flow of the Atchafalaya River to discharge into the Gulf of Mexico through Wax Lake Outlet would occur over time under without-project conditions.

A.6.102. This shift in flows, along with concurrent delta development, would cause a loss in fresh bays in the marsh area. Thus, recreational estuarine fishery resources decrease.

A.6.103. Delta building and marsh land accretion would occur as the flow of water and sediments into Atchafalaya Bay continues. Additions to the land mass that currently exist in the Atchafalaya Delta Wildlife Management Area would improve waterfowl habitat, as well as habitat for furbearers. With an increase in habitat, potential for consumptive recreational activities, such as hunting and trapping, would be enhanced in the Atchafalaya Delta area, although total net losses resulting from land conversion are much too great to be offset by these minimal increases.

FISHING, HUNTING, AND TRAPPING (COMMERCIAL ASPECTS)

A.6.104. In the absence of Federal action, commercial fishing and trapping will be adversely affected by decreasing water levels and the clearing of woodlands within the lower floodway. Additionally, the creation of delta in the Atchafalaya Bay area would probably impact favorably on commercial fishing and trapping.

A.6.105. The net impact of these effects on commercial fishing is expected to be adverse. In the project area, the loss of forest wetland would result in reduced production levels for all species. In the Atchafalaya Bay area, the loss of certain marsh types would be offset by the process of delta creation. For the bay area, the impact of this redistribution on commercial fishing could be expected to be neutral. In summary, therefore, the net impact on commercial fishing is expected to be adverse. For the three dominant species taken in the basin, crawfish, catfish, and buffalofish, it is estimated that maximum sustainable yield in the lower floodway could drop by as much as 39, 37, and 31 percent, respectively.

A.6.106. The overall net impact on commercial trapping is expected to be negative. In the lower floodway, the loss of suitable habitat would result in population reductions for mink, nutria, and racoon of 28, 15, and 32 percent, respectively. In the lower Atchafalaya River complex populations are not projected to vary as significantly. The mink population is projected to be stable; whereas, nutria would increase slightly (4%) and raccoon would decrease slightly (2%).

INDUSTRY

A.6.107. As described in Section 5, the principal industries in the study region are industrial and miscellaneous chemicals and allied products, food and kindred products, sugar, and lumber and wood products. The Morgan City area is of great significance to the region's industry as it is the focal point for the manufacture of items used in the exploration and production of oil and gas resources in the Louisiana Gulf region.

A.6.108. Perhaps the most significant development to the study region's industry in the absence of Government action would be the effects of rising backwater stages on the Morgan City area industrial complex. The unprotected industry located along US Highway 90, stretching several miles in an easterly direction from the eastern edge of Morgan City, would be most severely impacted. For the infrequently occuring event (100-year frequency) water levels would rise by as much as 2.0 to 2.5 feet above existing (1980) conditions. In addition to experiencing higher stages, the frequency of property damaging stages in this area would also increase. The existing property damaging stage occurs at a frequency of approximately once every 35 years. By the year 2030, this frequency would increase to about once every two years. In the absence of a response by affected industry to this significantly increased flood hazard, annual flood damages would increase dramatically. Under existing conditions average annual physical damage to the industrial development along this stretch of US Highway 90 is estimated to be approximately $300,000. These damages would increase to approximately $15.1 million

by the year 2030. This increase in damage is based on the current development. In addition to the physical damage caused by higher stages, the duration of property-damaging stages would increase, resulting in prolonged interruptions to the production process.

A.6.109. It is questionable whether industry in this area would continue to incur annually increasing flood damages and disruptions. When damages and disruptions reach some critical level, occupants of this area would be induced to relocate. This process would be accelerated when these industries are confronted with major decisions on capital replacements. If some or all of these industries are forced to relocate, the impact on the area's economy would be most severe.

Section 7 - PROBLEMS, NEEDS, AND OPPORTUNITIES

A.7.1. In discussing the problems, needs, and opportunities of the area, it is helpful to isolate the problems and corresponding needs. Table A-7-1 contains a summary of problems and needs of the study area. Within the framework of the goals and objectives of the Agency Management Group (see Section 9 of this Appendix), a dominant objective and the common denominator for any proposed action is that the project must be able to convey the design floodflows (while protecting life and property adjacent to the floodway). The problems relating to this objective must be solved and needs must be met. The other needs, including preserving or enhancing environmental values, providing for public recreation opportunities, and maximizing delta development, must be met within the framework of providing an adequate flood control system.

Old River Control Complex and the Red River Backwater Area

A.7.2. The Old River control structure and the Morganza control structure serve as the inlets to the floodway system, and have been described in detail in Section 4 of this Appendix. The problems and needs of this area are presented in the following paragraphs.

DEFICIENCIES IN OLD RIVER CONTROL COMPLEX

A.7.3. Since its construction (1959-1962), the Old River Control complex has experienced numerous hydraulic and structural problems in the form of scouring damages, marine accidents, and stilling basin damages. A summary of the damages and repairs, shown in Table A-7-2, reflects that scour has been the most common problem. Experience has shown that scouring problems rapidly increase as the differential head (headwater stage minus tailwater stage) at the low sill structure approaches or exceeds 13-16 feet, depending on the gate positions. Rehabilitation work since 1973 has improved hydraulic flow characteristics at the structure and provided increased scour protection both upstream and downstream. This has reduced the potential for future scour damages but has not completely eliminated it.

A.7.4. There is a structural constraint on the low sill structure resulting from 1973 flood damages. In that flood, foundation material

TABLE A-7-1

PROBLEMS AND NEEDS

Item	Problems	Needs
Old River Control and Red River Backwater Area	1. Deficiencies in Old River Control complex: a. Weakened low sill structure. b. Channel scour problems. c. Draw on river traffic. d. Control over sediment diversion	1. Convey the design flows for flood control.
	2. Observed deterioration of Mississippi River channel.	2. Prevent the Mississippi River from changing its course.
	3. Flow regulation through the Old River low sill structure.	3. Regulate flow into the Atchafalaya River to: a. Decrease water levels in the Red River Backwater Area to enhance agricultural productivity. b. Increase water input to the Atchafalaya Basin for the enhancement of aquatic resources.
Atchafalaya Basin Floodway System. This includes the West Atchafalaya Floodway, the Morganza Floodway, and the Lower Atchafalaya Basin Floodway.	1. The present conveyance capacity in the lower floodway is inadequate for major floods, due to: a. Poor levee foundations. b. Continuing overbank sedimentation. c. Immature main channel. d. Incomplete levee system.	1. Convey the design floodflows through the floodway.
	2. The environment of the basin is rapidly changing, due to: a. Changing water regimes resulting from natural and man-made actions. b. Sedimentation. c. Land conversion actions.	2. Maintain the unique environment of the Atchafalaya Basin.

TABLE A-7-1

PROBLEMS AND NEEDS

Item	Problems	Needs
Old River Control and Red River Backwater Area	1. Deficiencies in Old River Control complex: a. Weakened low sill structure. b. Channel scour problems. c. Draw on river traffic. d. Control over sediment diversion	1. Convey the design flows for flood control.
	2. Observed deterioration of Mississippi River channel.	2. Prevent the Mississippi River from changing its course.
	3. Flow regulation through the Old River low sill structure.	3. Regulate flow into the Atchafalaya River to: a. Decrease water levels in the Red River Backwater Area to enhance agricultural productivity. b. Increase water input to the Atchafalaya Basin for the enhancement of aquatic resources.
Atchafalaya Basin Floodway System. This includes the West Atchafalaya Floodway, the Morganza Floodway, and the Lower Atchafalaya Basin Floodway.	1. The present conveyance capacity in the lower floodway is inadequate for major floods, due to: a. Poor levee foundations. b. Continuing overbank sedimentation. c. Immature main channel. d. Incomplete levee system.	1. Convey the design floodflows through the floodway.
	2. The environment of the basin is rapidly changing, due to: a. Changing water regimes resulting from natural and man-made actions. b. Sedimentation. c. Land conversion actions.	2. Maintain the unique environment of the Atchafalaya Basin.

TABLE A-7-1
(Continued)

PROBLEMS AND NEEDS

Item	Problems	Needs
	3. Future navigation access is threatened by: a. Changing water regimes b. Sedimentation.	3. Maintain navigation access.
	4. Existing public recreation access is inadequate.	4. Provide public recreation access and opportunities.
Outlets of the floodway system, including Wax Lake Outlet and the Lower Atchafalaya River	1. The present combined capacity of the two outlets is inadequate for major floods, due to: a. Insufficient channel cross section b. Insufficient levee height and overbank flow area. c. Lack of control over the distribution of flow between the two outlets.	1. Convey the design floodflows out of the floodway, through the Teche ridge and into the Gulf.
	2. Navigation problems through Berwick Bay.	2. Maintain navigation access through Lower Atchafalaya River.
Lower Atchafalaya River backwater complex, including the area northeast of Morgan City and the Terrebonne marshes.	1. The present protection from backwater flooding is inadequate due to: a. Rising flowline. b. Development (Industrial, commercial, residential and agricultural) in low lying areas. c. Insufficient channel capacity in the Lower Atchafalaya River. d. Lack of control over the distribution of flow between the two outlets.	1. Provide protection against backwater flooding induced by flood flows in the Lower Atchafalaya River.
Atchafalaya Bay, including the marshes adjacent to the bay	1. Future management plans are not defined due to: a. Rapidly changing conditions b. Insufficient technical data.	1. Provide a management plan for the Atchafalaya Bay and adjacent marshes.

TABLE A-7-2
(Continued)

PROBLEMS AND REPAIRS

Date	Problem/Damage	Location	Repair	Cost ($)
Aug 71	Scouring	Inflow channel	4,700 squares concrete mattress	131,000
Apr-Jun 73 (73 flood)	Scour hole -60 ft. NGVD	Forebay, wingwall and under structure	335,000 tons riprap, 33,000 cu. yd. grout	16,542,000 1/
Oct 73-Aug 74	Marine accident	Gate bay 5	-	-
Apr-Jun 74 (74 high water)	Scour hole bank erosion -120 ft. NGVD	Outflow channel	210,000 tons riprap	*
Mar 75 (75 high water)	Scour	Forebay	8,700 tons riprap	324,000
Aug-Dec 76	Stilling basin repair	Stilling basin	-	-
Sep 77	Scouring	Outflow channel	-	-
Sep 79	Scouring	Overbank structure	-	-
Nov 80	Stilling basin repair	Stilling basin	-	-

1/Total cost of repairs performed during 1973 and 1974 high water during a continuing repair contract, including exploratory drilling.

beneath a portion of the low sill structure was undermined and eroded, permanently weakening the structure. Subsequent to the 1973 structural damage, a detailed foundation, hydraulic, and structural analysis of both the low sill and overbank structures was made. This analysis is contained in Design Memorandum No. 12, "Stability Analysis, Old River Low Sill and Overbank Structures, FC, MR&T, Old River Control, Louisiana". The analysis indicated that, in addition to the structural and foundation problems, future hydraulic conditions will be more adverse than anticipated during design of the complex. As a result of the analysis, subsequent model tests and investigations, and subsequent letter reports, an extensive rehabilitation program for the Old River project has been initiated. Rehabilitation measures that have been completed or are planned are shown in Table A-7-3. The direct rehabilitation of the Old River complex is essentially completed and the low sill structure, with a single exception, is a dependable and damage-resistant structure. That exception is a reduced capacity in the pile foundation under the structure. Because of this permanent impairment, the current safe limit of differential head (headwater stage versus tailwater stage) that can be placed on the structure is 22 feet, as compared to 37 feet before the flood damages. This limitation does not hinder the normal operation of the low sill structure, but does cause concern about its ability to deal with emergency situations, which may cause higher than normal differential heads. While this deficiency cannot be remedied by direct action (repair of the damaged foundation), it can be dealt with effectively by the construction of an auxiliary structure, the existence of which will prevent differential heads from exceeding the safe limit. Construction of the auxiliary structure began in 1981 and will be completed in 1985. In the interim, the low sill structure is fully capable of dealing with all normal operational conditions, including major floods.

A.7.5. The low sill structure diverts a sizeable portion of the Mississippi River's flow and, during the years of operation, the deepest part of the Mississippi River at this point has progressively moved toward the low sill inflow channel. These factors may induce unwary or unattended river traffic to be "pulled" or "drawn" into the inflow channel and into the low sill structure. Loose barges were drawn into the structure in 1964 and 1965. The "draw" characteristic does not in itself place any operating constraints on the structure, but the possible consequences of another marine accident imply a grave threat to the structure, particularly with the present limitation on differential head (22 feet). Since the occurrence of these two accidents, a picket boat has been stationed near the junction of the inflow channel and the Mississippi River. The picket boat monitors traffic on the river, checks for unsafe conditions, and renders assistance to vessels in distress. A new and more powerful picket boat is currently being constructed to replace the one now on duty. To improve the ability to detect vessels further upstream and at night, a radar detection system, with a monitor on the picket boat, is currently being constructed. The planned auxiliary structure will reduce the threat to marine traffic.

TABLE A-7-3

REHABILITATION MEASURES - OLD RIVER COMPLEX

Rehabilitation Measure	Purpose	Status
Install additional piezometers		Construction complete
Gate leaf and structure modification	To allow either orifice or full gate closures	Construction complete
Outflow channel protection	To stabilize the outflow channel by providing additional riprap	Construction complete
Inflow channel protection	To stabilize the inflow channel and adjacent Mississippi River bank by providing additional riprap and revetment	Construction complete
Overbank structure modification	To provide capability to function under future hydraulic conditions	Construction in progress
Install riser pipe and pressure gages in drainage manholes		Construction complete
Construct spare gate leaves		Construction in progress
Install additional piezometers		Construction in progress

DETERIORATION OF MISSISSIPPI RIVER CHANNEL

A.7.6. Since construction and operation of the Old River control complex, the Mississippi River channel downstream between the complex and Morganza control structure has shown a marked decrease in channel capacity. This decrease is discussed in detail in DM No. 12. The requirement to maintain an adequate channel for flood control purposes in the Mississippi River below Old River complex also imposes limits within which the structure must be operated and, conversely, restricts the freedom to regulate flows into the Atchafalaya Basin Floodway system.

VARIOUS INTEREST GROUPS DESIRE TO CHANGE THE EXISTING FLOW REGULATION

A.7.7. In 1964 and 1965, loose barges were drawn into the Old River low sill structure and it had to be closed for barge salvage operations. While it was closed, water levels in the Red River backwater area dropped dramatically, and farmers became aware of the potential of the Old River project for reducing flows to enhance agricultural production. At public meetings held in late 1968, agricultural interests in the Red River backwater area requested that stages in the backwater area be regulated to low levels at the junction of the Red and Black Rivers as early as practicable during the growing season. At those same public meetings, environmental interests requested that additional flows be diverted through the structure to the Atchafalaya Basin during low water periods.

Atchafalaya Basin Floodway System

A.7.8. This area encompasses all the project within the guide levees, from the inlets down to the outlets. The area, and the features therein, have been described in detail in Section 4, of this Appendix. The problems and needs of this area are discussed in the following paragraphs.

INADEQUATE CONVEYANCE CAPACITY (LOWER FLOODWAY)

A.7.9. The flood conveyance capacity in the upper portion of the floodway system (i.e., West Atchafalaya Floodway, Morganza Floodway, and the leveed portion of the Atchafalaya River) is adequate for the design flows. However, below the latitude of Krotz Springs, the conveyance capacity becomes inadequate for design flood flows, with

the deficiencies generally increasing in magnitude toward the lower end of the floodway at about mile 100. The inadequate conveyance capacity is due to insufficient heights of the confining levees which, in turn, is due to a combination of several factors, as follows:

- The flow regime of the Atchafalaya River is rapidly changing as the river seeks to establish an equilibrium slope. The net effect is that flowlines in the upper basin are tending to lower while flowlines in the lower basin are tending to rise. These trends will continue, at a decreasing rate, until equilibrium is obtained.

- The main channel in the basin has not matured. This results in extensive overbank flows and sedimentation for medium and high river stages, leading to increases in flowlines as noted above.

- Overbank sedimentation, by increasing the land elevations within the floodway, acts to decrease the available flow capacity below a given elevation and to increase the flood stages. This phase of the problem is compounded by the lack of a mature main channel.

- The foundations upon which the guide levees (East and West Atchafalaya Basin Protection Levees) are constructed are extremely poor in the lower part of the floodway, resulting in severe settlement problems. As a result, it has been extremely difficult in some areas to construct and maintain the guide levees to the required grades.

RAPIDLY CHANGING BASIN ENVIRONMENT

A.7.10. The environment within the basin, in terms of water and land areas and types of predominant vegetation, is changing at a relatively rapid rate. This is largely due to the fact that the Atchafalaya River is a young river. It is actively seeking to develop a flood plain, an equilibrium slope, and a mature channel. The rate of environmental change is also attributed to the basin's periodic use as a floodway. It's changing flow regime in the basin together with extensive sedimentation continue to convert areas that were formerly open water or swamp to land. As land areas emerge and vegetate, they are cleared for more economically profitable use, such as soybean production. The conversion of open water and swamp to forestland, followed by conversion of forestland to cropland, has eliminated many of the wetland and forest areas that once existed in the basin north of I-10. This process of change continues in the southern basin, and will eventually result in elimination of much of the remaining swampland and privately-owned forestland. The conversion to cropland will cause a dramatic reduction in the ability of the project area to support significant populations of fish and wildlife.

ANTICIPATED NAVIGATION PROBLEMS

A.7.11. Although there are presently no problems with commercial or recreational navigation access, the changing water regime and sedimentation may cause such problems in the future if present maintenance activities are not continued.

INADEQUATE PUBLIC ACCESS

A.7.12. The Atchafalaya Basin offers vast potential for nonconsumptive recreation, as well as for hunting and fishing by the general public. At present, adequate public access facilities are limited, creating a need for the following activities: bicycling, tent camping, hiking, horseback riding, nature walks, picnicking, multi-use fields, multi-use courts, playgrounds, boating, fishing, and waterskiing.

OUTLETS OF THE FLOODWAY SYSTEM

A.7.13. This encompasses the two outlets of the floodway system (Wax Lake Outlet and the Lower Atchafalaya River), including the channels between the lower floodway and Atchafalaya Bay. The area, and the features therein, have been described in detail in Section 4 of this Appendix. The problems and needs of this area are as follows:

- The present combined conveyance capacity of the two outlets, through the Teche Ridge, is inadequate to convey the design flood flows. This is due to a combination of the following factors: The confining levees are of inadequate height; the distance between the levees is limited; that is, there is restricted overbank flow area; the overall capacity of the Wax Lake Outlet and Lower Atchafalaya River has decreased; and, there is no control for flow distribution between the two channels.

- The Berwick Bay has required dredging for navigation in the past due to shoaling.

LOWER ATCHAFALAYA RIVER BACKWATER COMPLEX

A.7.14. This area includes those lands extending from just south of Baton Rouge to the Gulf of Mexico, roughly bounded on the east by the Texas and New Orleans Railroad and the Houma Navigation Channel and on the west by the Lower Atchafalaya Basin Floodway.

A.7.15. The Avoca Island levee, an extension of the East Atchafalaya Basin Protection Levee, was built to limit project design flood stages in this area to generally the same as those which occurred in the 1945 flood. However, since construction of the levee and the Bayou Boeuf lock would change the Morgan City-Amelia area from one affected by headwater flow to one affected by backwater flow, the levee could not exactly reproduce the conditions of the 1945 flood. The 1945 flood stage at Morgan City was 6 feet NGVD in the Atchafalaya River and was about 4 feet NGVD between Morgan City and Gibson, and between Morgan City and Pierre Pass. For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City, in the late 1940's, was computed to 4 feet NGVD. To achieve the required project flood stage east of Morgan City of 4 feet NGVD, the new levee south of Morgan City was alined parallel to the Atchafalaya River, extending about 13 miles south of the city, and terminating at a flowline elevation then estimated at about 7.5 feet. The degree of protection provided by the levee varied with the location elevation of the protected area. For all lands above elevation 4 feet NGVD, complete protection against a project flood was achieved. Lands below 4 feet NGVD, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reduction would diminish with distance eastward from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. As the delta continues to build, stages at the existing levee terminus would ultimately rise by more than 6 feet, compared with conditions of 1945. Despite rising stages, agricultural, residential, commercial, and industrial development has continued; however, long-term growth for this area is questionable in the absence of additional flood protection.

ATCHAFALAYA BAY

A.7.16. This area includes the Atchafalaya Bay and the adjacent marshlands. The principal need of this area is a comprehensive management plan for the existing and newly-forming marshlands, compatible with the required flood control and navigation features.

Section 8 - PLANNING CONSTRAINTS

A.8.1. As discussed in the previous section, the overwhelming planning constraint is that the project must be able to safely convey the project flood. Other constraints are inherent in the applicable laws and executive orders. These are as follows:

- Clean Water Act of 1977, 33 U.S.C. 1251 et seq. (Sec 404).

- Coastal Zone Management Act of 1972, as Amended, 16 U.S.C. 1451 et seq.

- Endangered Species Act of 1973, as Amended, 16 U.S.C. 1531 et seq.

- Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq.

- National Historic Preservation Act of 1966, as Amended, 16 U.S.C. 470 et seq.

- Archeological and Historic Preservation Act of 1974, as Amended, 16 U.S.C. 469 et seq.

- Estuary Protection Act.

- Federal Water Project Recreation Act.

- Land and Water Conservation Fund Act.

- Marine Protection Research and Sanctuaries Act of 1872, as Amended.

- EO 11593, Protection and Enhancement of the Cultural Environment, 13 May 1971.

- EO 11988, Floodplain Management, 24 May 1977.

- EO 11990, Protection of Wetlands, 24 May 1977.

- Analysis of Impacts on Prime and Unique Farmlands in EIS, CEQ Memorandum, 30 August 1976.

- National Environmental Policy Act of 1969, as Amended, 42 U.S.C. 4321 et seq.

- EO 11514, Protection and Enhancement of Environmental Quality, 5 March 1970, as Amended by EO 11991, 24 May 1977.

- Clean Air Act, as Amended, 42 U.S.C. 7401 et seq.
- Principles and Standards.
- River and Harbor Act.
- Watershed Protection and Flood Prevention Act.
- Wild and Scenic Rivers Act.

Section 9 - PLANNING GOALS AND OBJECTIVES

A.9.1. Aside from the co-equal national objectives of environmental quality and national economic development, goals and objectives specific to the Atchafalaya Basin study were developed by the Agency Management Group. The primary goal is to develop, as soon as possible, an implementable multipurpose plan to protect south Louisiana from Mississippi River and tributaries floods while retaining and restoring the unique environmental features and long-term productivity of the natural environment of the basin.

A.9.2. Within this overall goal, specific objectives can be defined. Among these are:

- Flood Control--Implement a flood control system that will safely pass the project flood to the Gulf of Mexico in an environmentally sound manner. Reduce to the maximum extent practical the deposition of sediments that reduce the ability of the floodway to pass the project flood.

- Natural Environment--Retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands.

- Agricultural Activities and Mineral Development--Allow agricultural activities and mineral development, provided such activity does not interfere with the goals relative to flood control or the natural environment.

- Delta Formation--Maximize natural delta formation in Atchafalaya Bay while providing for navigation and passage of the project flood.

- Public Accessibility--Maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway.

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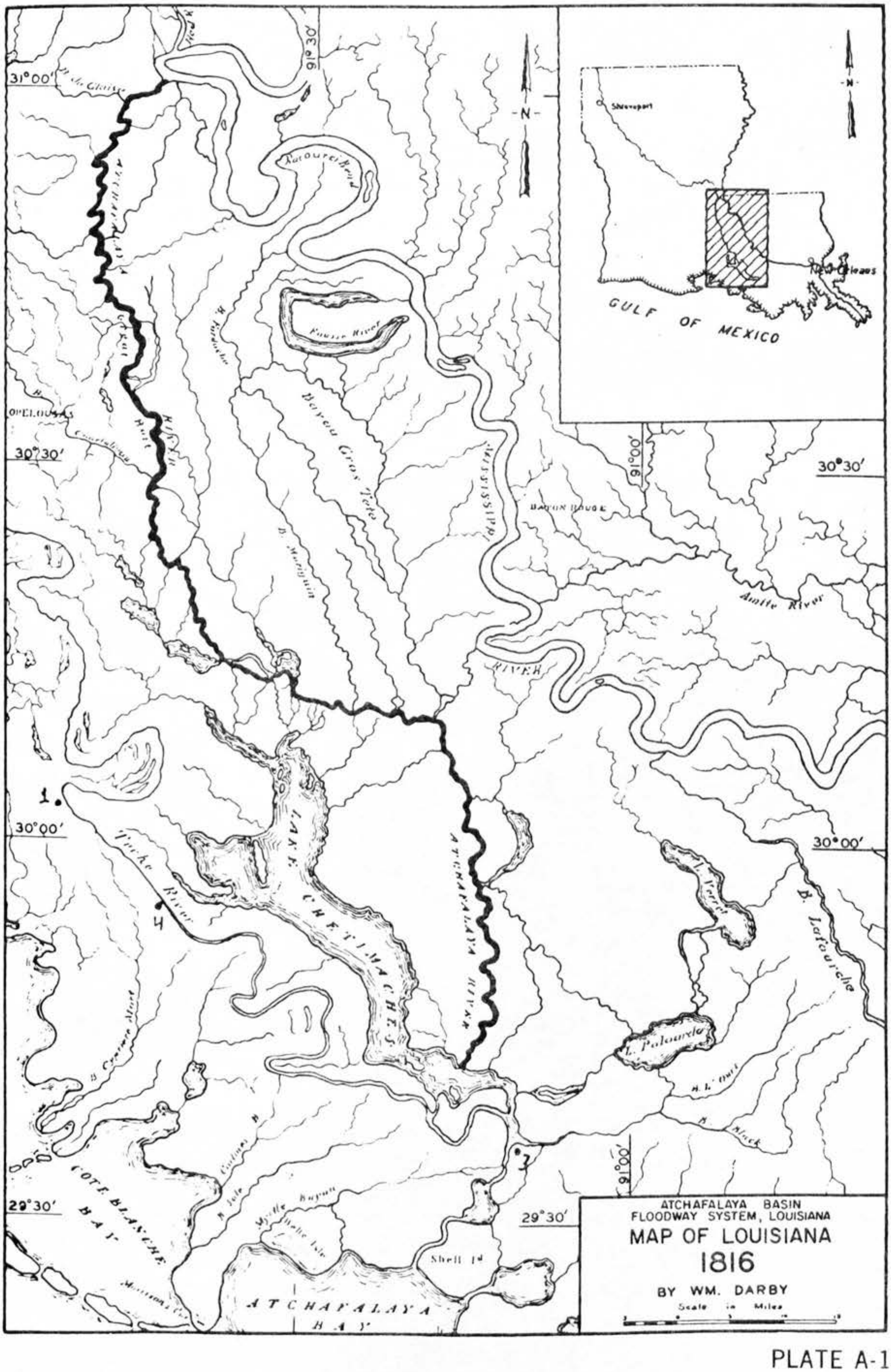
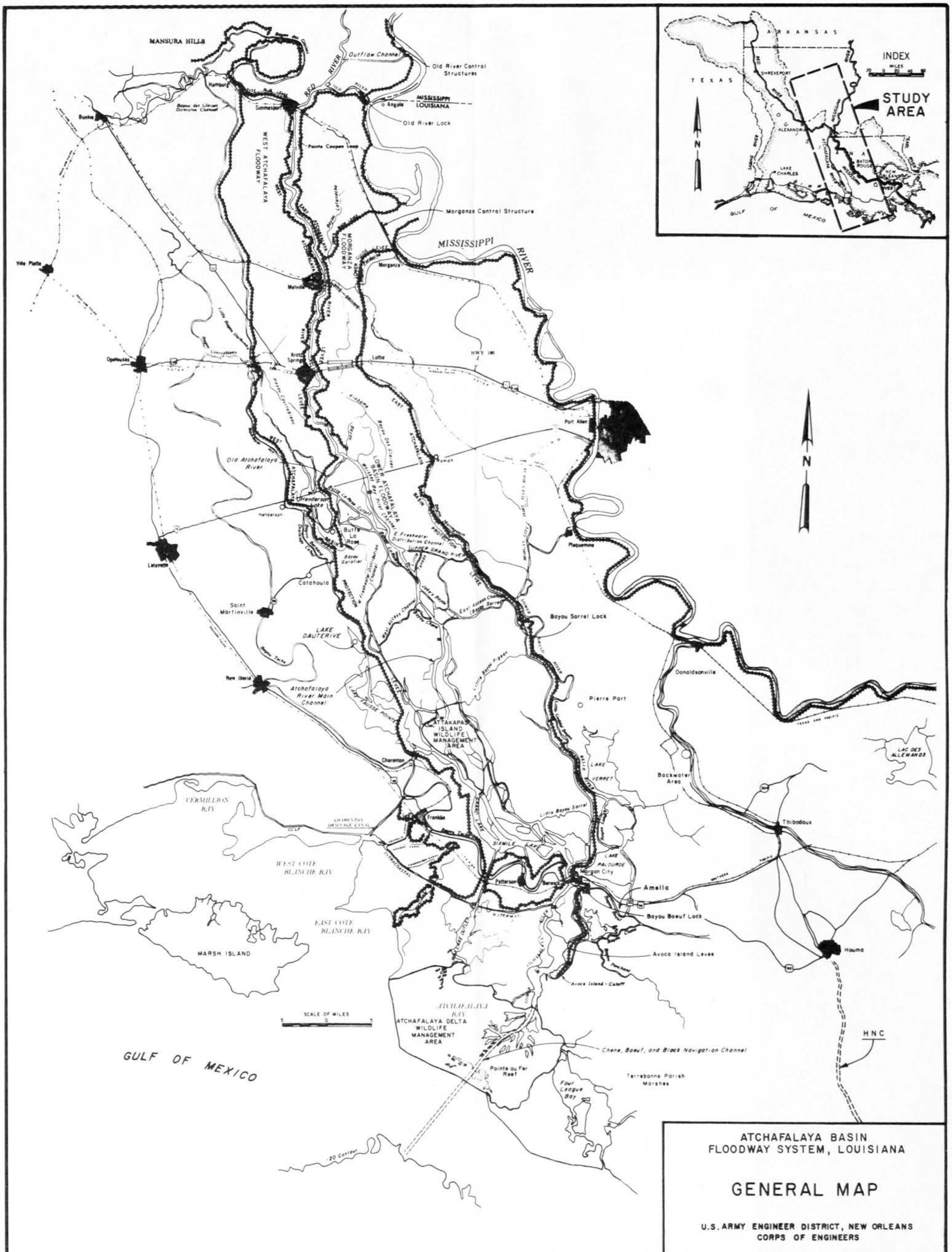

31°00'
91°30'
-N-
Racourci Bend
Fausse River
Bayou Gros Tete
MISSISSIPPI
OPELOUSAS
30°30'
91°00'
BATON ROUGE
Amite River
RIVER
1.
30°00'
Teche River
LAKE CHETIMACHES
ATCHAFALAYA RIVER
L. Verret
B. Lafourche
L. Palourde
29°30'
COTE BLANCHE BAY
ATCHAFALAYA BAY
Shell Id
Shreveport
New Orleans
GULF OF MEXICO
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
MAP OF LOUISIANA
1816
BY WM. DARBY
Scale in Miles

PLATE A-1



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GENERAL MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-2

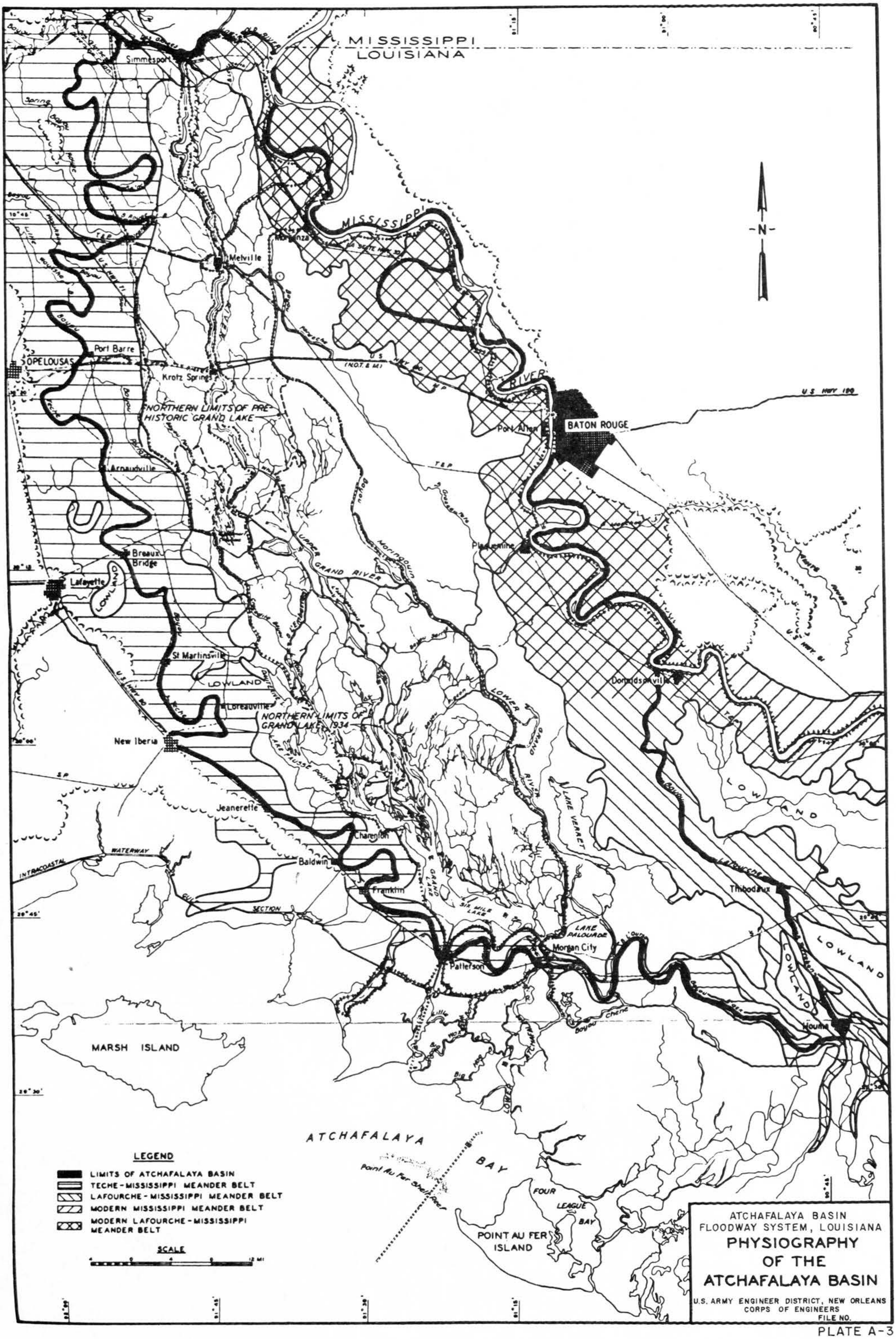
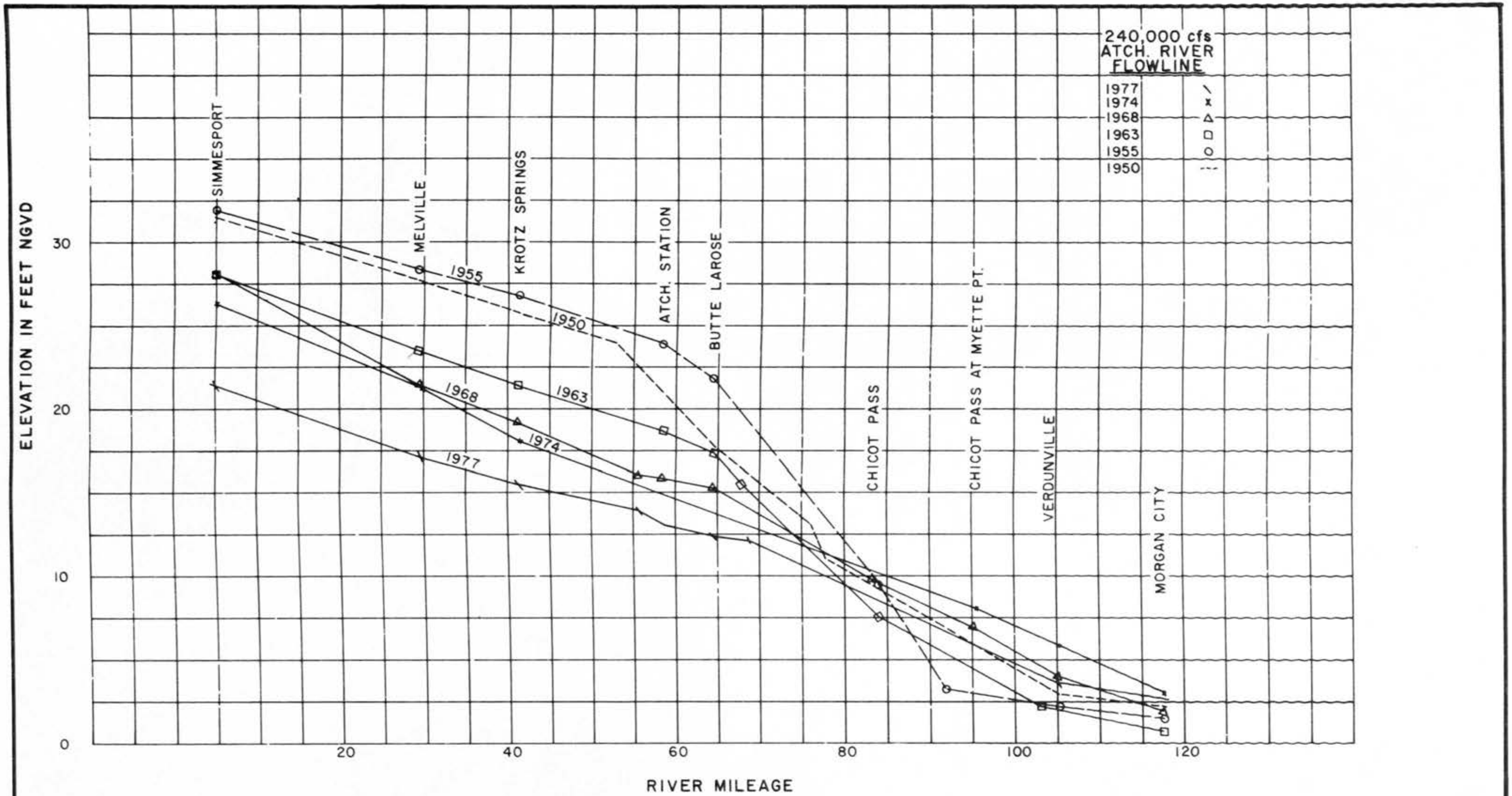


PLATE A-3

PLATE A-3



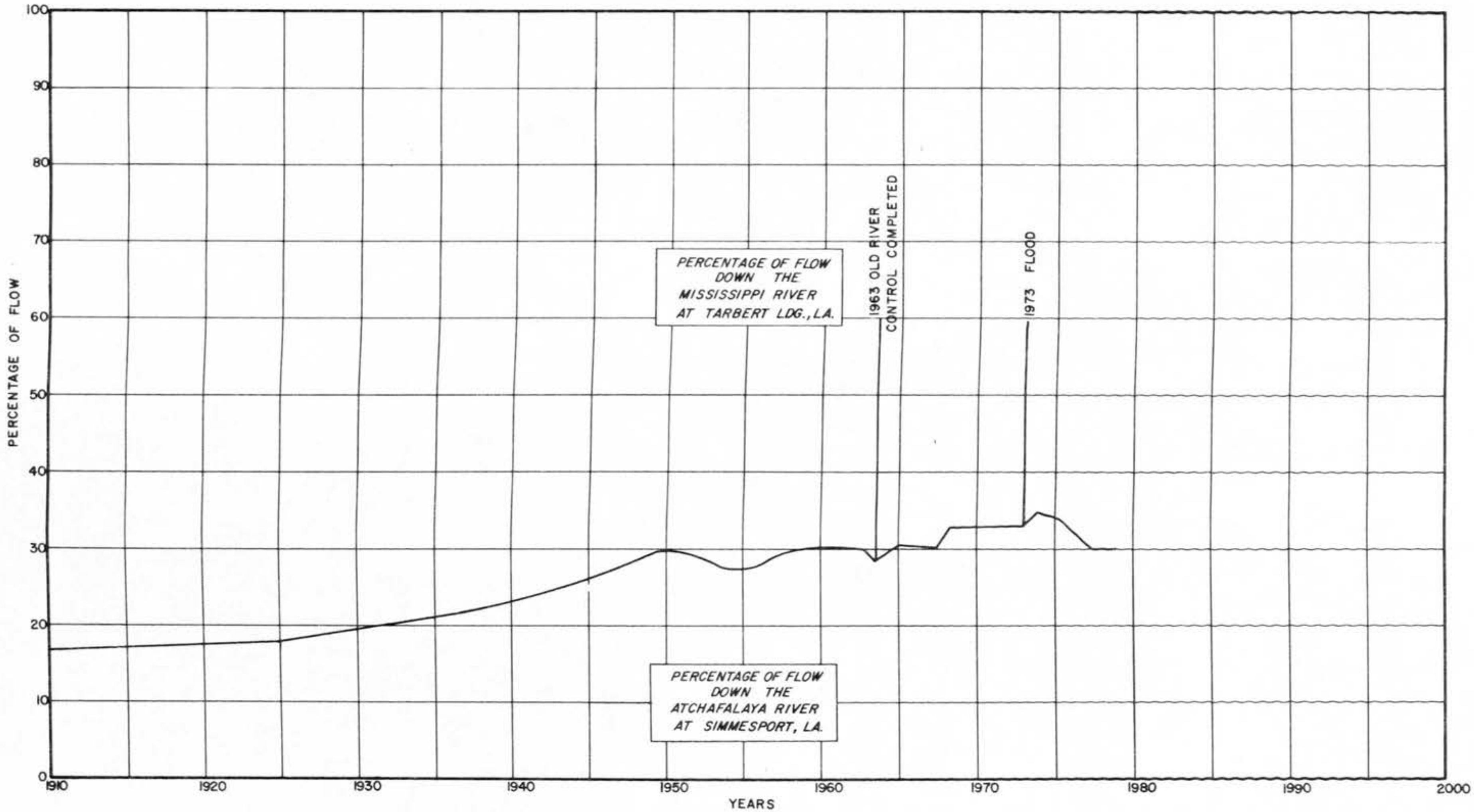
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA RIVER
STAGES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS, L.A.
CORPS OF ENGINEERS

DATE FILE NO.

PLATE A-4



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

TOTAL FLOW AT
LATITUDE OF OLD RIVER

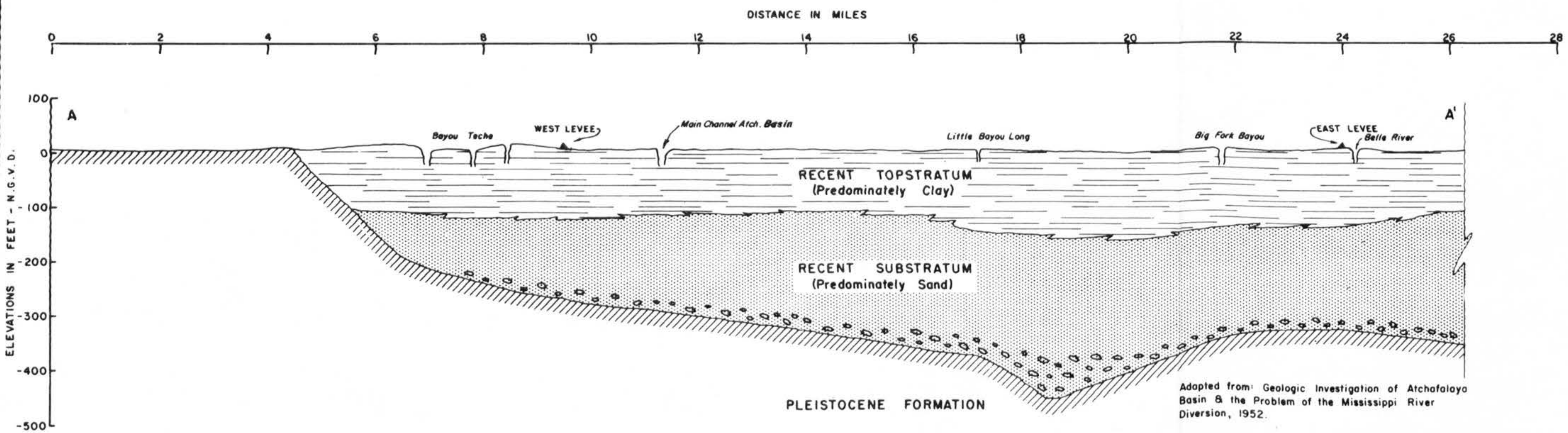
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

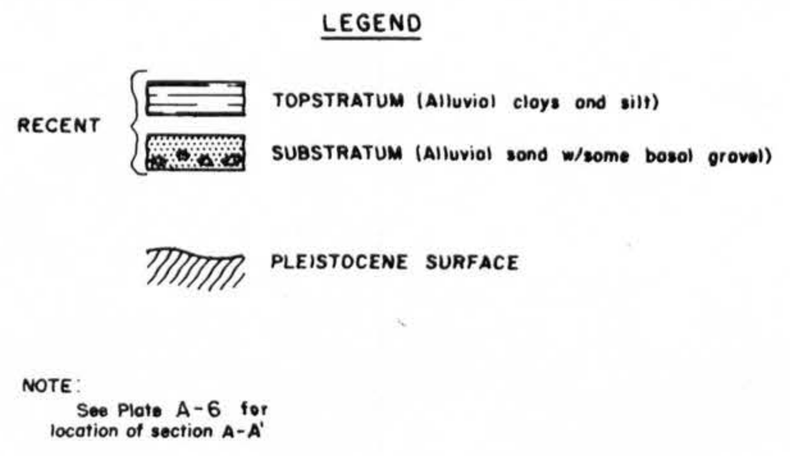
PLATE A-5

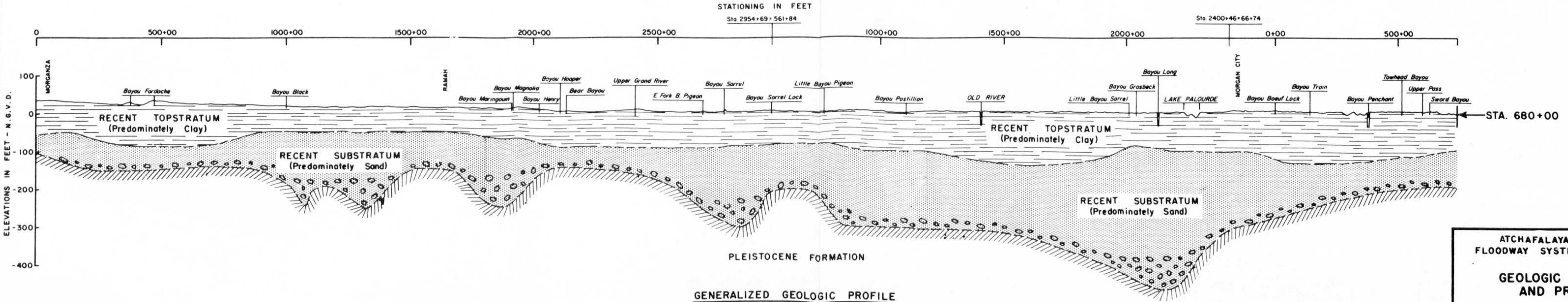

MISSISSIPPI
RIVER
OLD RIVER
RED RIVER
Morganza
Mc Knealy
Simmesport
Melville
ATCHAFALAYA
RIVER
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
Ramah
Bayou Sorrel Lock
ATCHAFALAYA BASIN MAIN CHANNEL
Butte La Rose
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
Palmetto
Courtableau
Charenton
Franklin
Morgan City
Bayou Boeuf
LOWER ATCHAFALAYA RIVER
Sta. 680+00
ATCHAFALAYA BAY
EAST COTE BLANCHE BAY
LEGEND
Marsh deposit
Backswamp deposit
Deltaic deposit average 15' overlying backswamp clays
Natural levee deposit
Point bar deposit
Abandoned channel fill deposit
RECENT
PLEISTOCENE
Levee
Lock
Drainage structure
Floodgate
Pumping station
A – Franklin Canal Levees
B – Hanson Canal Levees
C – Thorgeson Canal Levees
D – West Bayou Sale Levees
E – East Bayou Sale Levee
F – Wax Lake West Levees
G – Wax Lake Outlet West Levee
H – Wax Lake Outlet East Levee
I – Wax Lake East Levee
J – Avoca Island Levee
K – Tiger Island Levee
NOTE:
Lakes and small streams not shown. Levees in the northern part of the basin, other than floodway protection levees are not shown.
SCALE OF MILES
SCALE IN FEET
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BASIN
SURFACE GEOLOGY
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE A-6



GENERALIZED GEOLOGIC CROSS SECTION A-A'





GENERALIZED GEOLOGIC PROFILE
ALONG EAST ATCHAFALAYA BASIN PROTECTION LEVEE
MORGANZA TO CUTOFF BAYOU

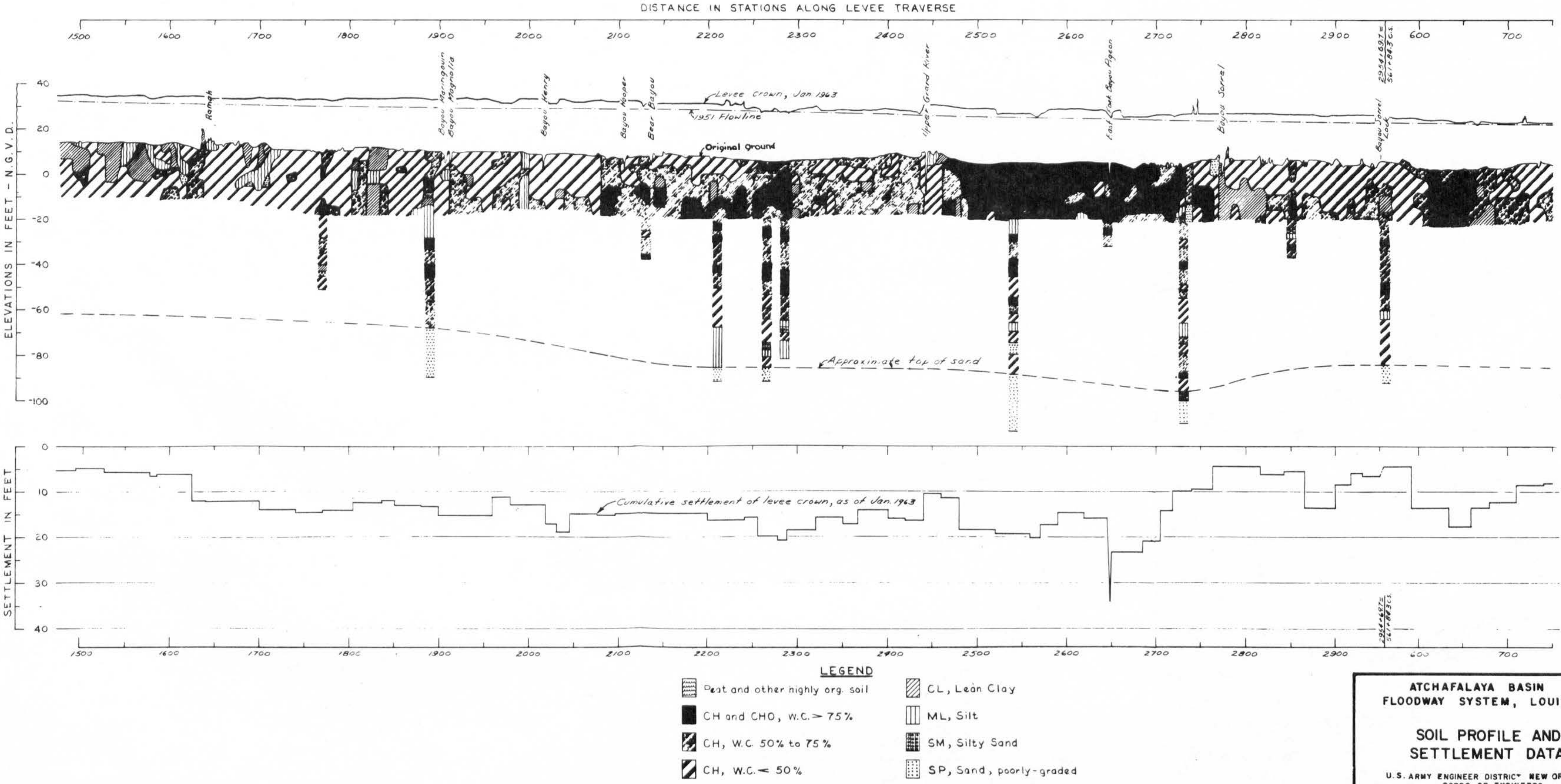
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

GEOLOGIC SECTION AND PROFILE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-7



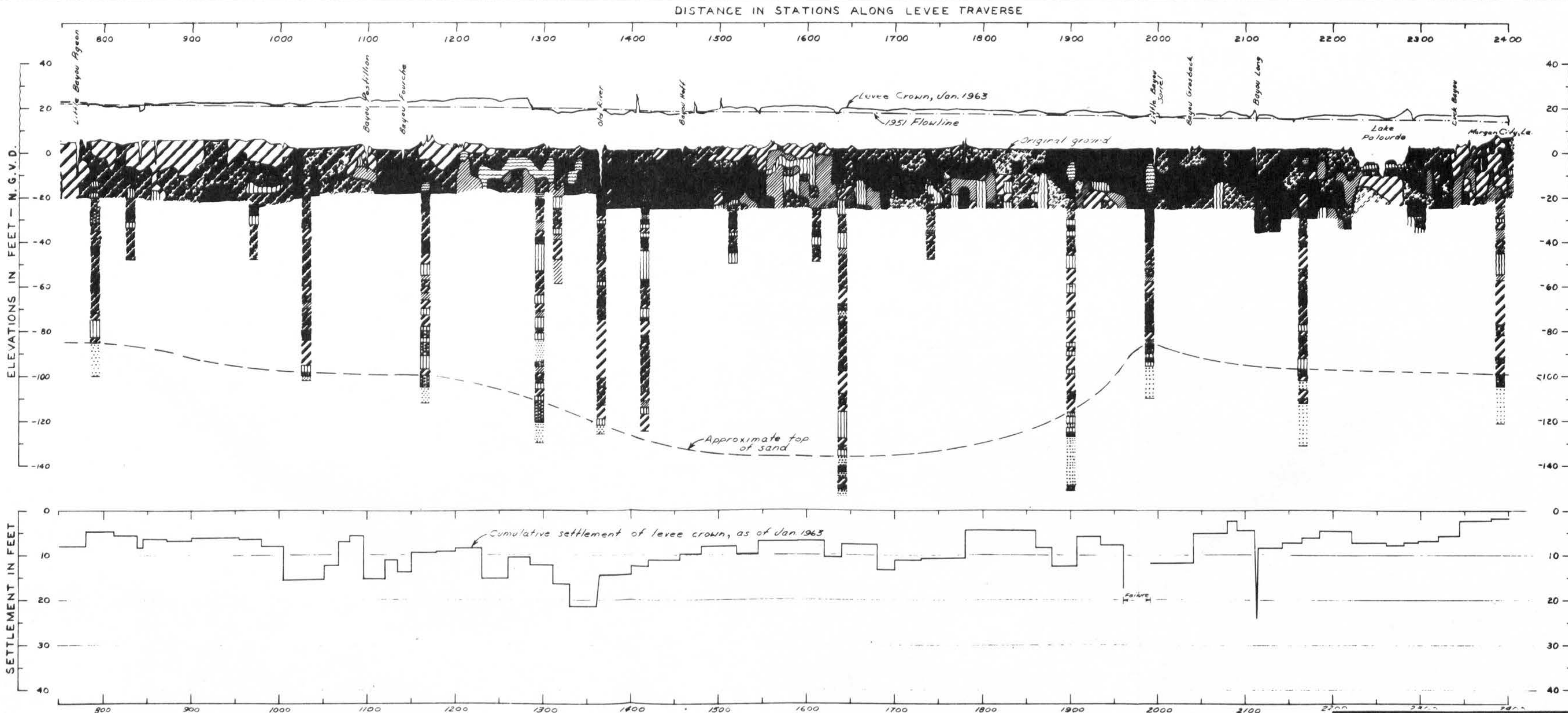
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND
SETTLEMENT DATA

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

PLATE A-8



NOTE: FOR LEGEND SEE PLATE A-8

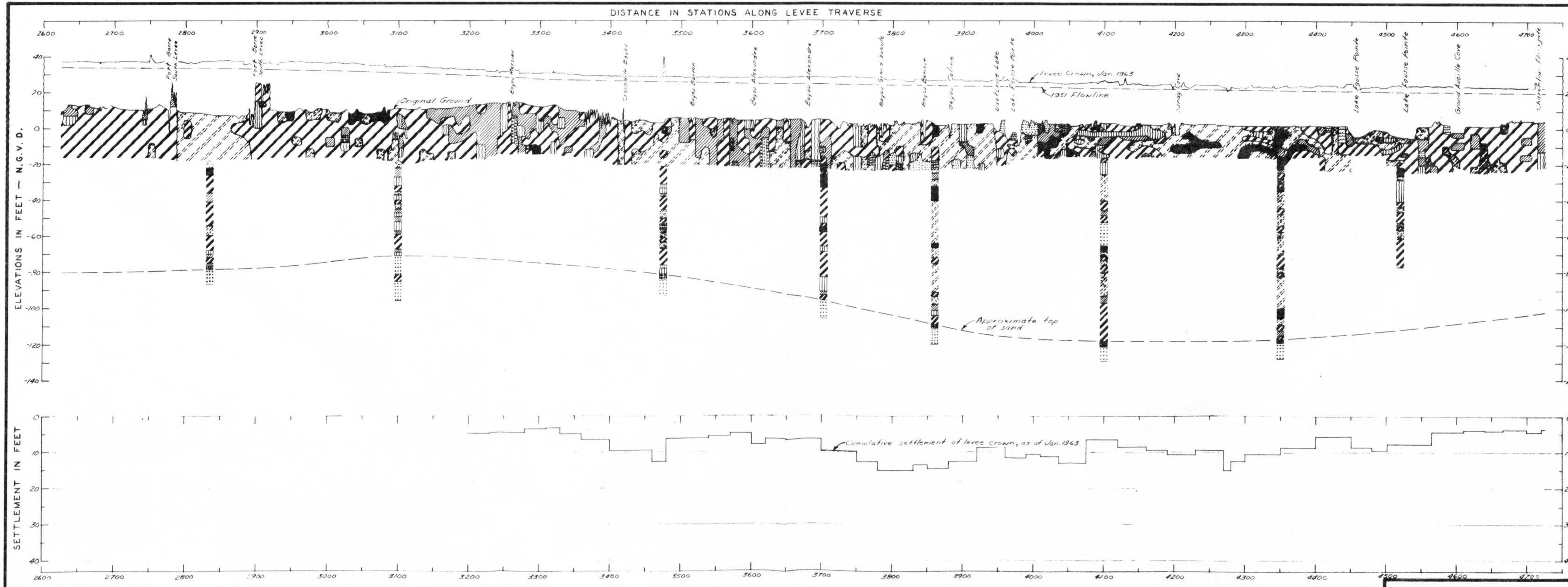
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND
SETTLEMENT DATA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-9



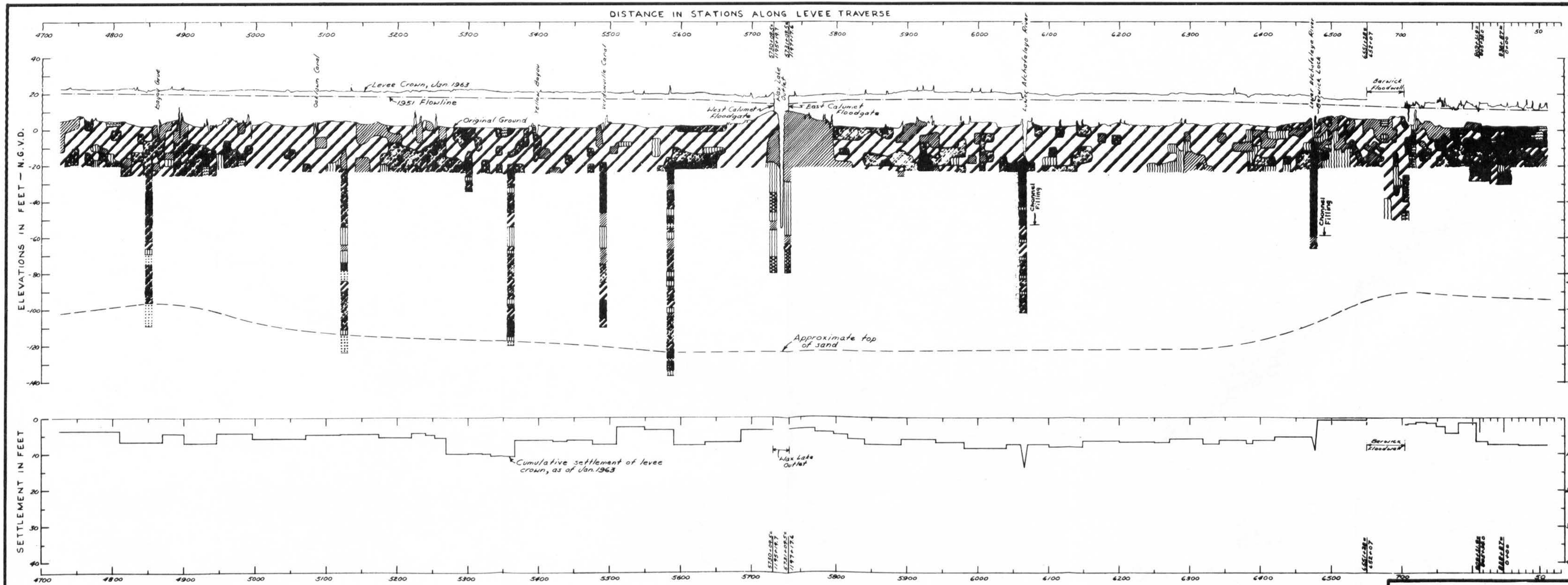
NOTE: FOR LEGEND SEE PLATE A-8

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND SETTLEMENT DATA

U. S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.



NOTE: FOR LEGEND SEE PLATE A-8

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

SOIL PROFILE AND
SETTLEMENT DATA

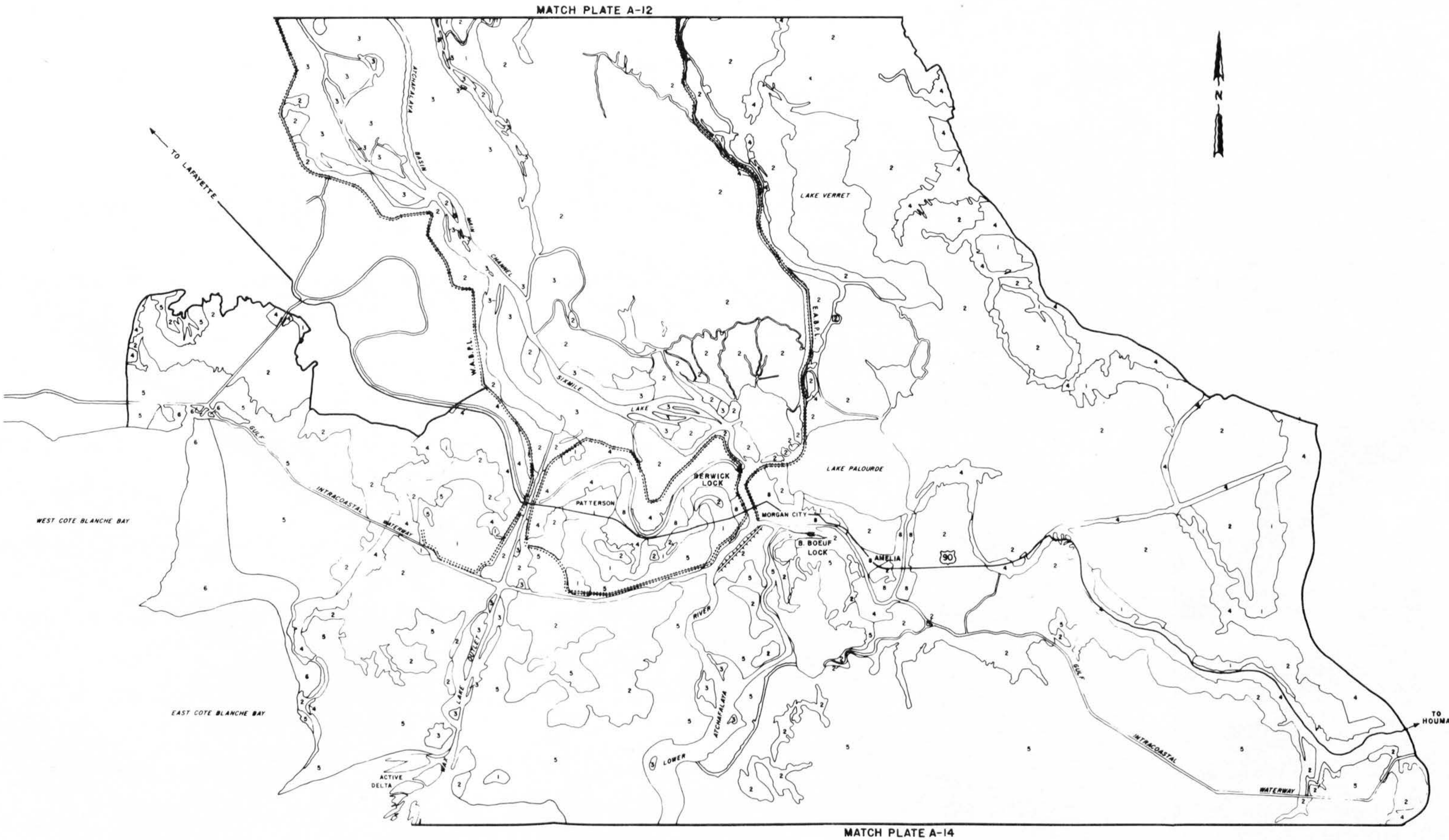
U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-11

MATCH PLATE A-13

PLATE A-12



LEGEND

1. MID TO LATE SUCCESSIONAL BOTTOMLAND HARDWOODS
2. CYPRESS-TUPELO OR CYPRESS-TUPELO MIXED WITH BOTTOMLAND HARDWOODS
3. EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS
4. CROPLANDS, PASTURE AND LEVEES
5. FRESH MARSH
6. BRACKISH MARCH
7. SALINE MARSH
8. URBAN DEVELOPMENT

UNDEFINED AREAS — OPEN WATER

SCALE

0 1 2 3 4 5 Miles

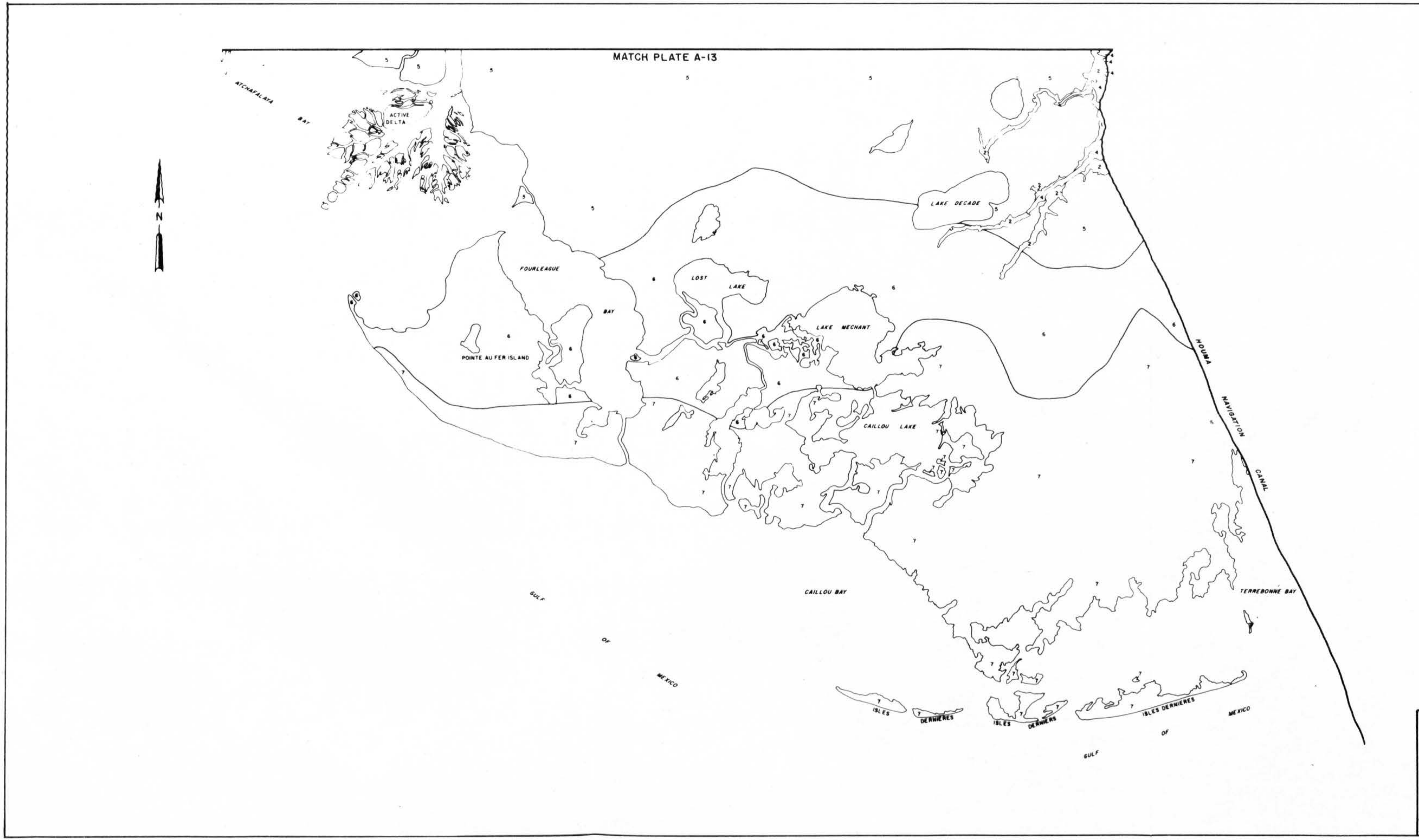
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE A-13



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

EXISTING LAND USE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

APPENDIX B

FORMULATION, ASSESSMENT AND EVALUATION OF DETAILED PLANS

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LIST OF PLATES

LIST OF PLATES (CONTINUED)

Appendix B

FORMULATION, ASSESSMENT, AND EVALUATION OF DETAILED PLANS

B.0.1. The information presented in this appendix details the development of plan alternatives from formulation, through assessment and evaluation, to recommendation. It also augments the main report by describing the study process and coordination efforts, planning rationale, the decision-making process, requirements for mitigation, and other technical data to support analyses, decisions, or recommendations. A general map of the study area (Plate B-1) is included for reference.

Section 1 - THE STUDY PROCESS AND HISTORY

The Study Process

B.1.1. Studies conducted by the US Army Corps of Engineers normally follow a three-stage process in which the four functional planning tasks of problem identification, formulation of alternatives, impact assessment, and evaluation occur within the framework of each stage. Stage 1 studies are reconnaissance level, stage 2 involves development of intermediate plans, and stage 3 concludes the general investigation process with development of detailed plans (Federal Register, Vol. 43, No. 135-Thursday, July 13, 1978). Figure B-1-1 shows the relationship of plan development stages and functional planning tasks.

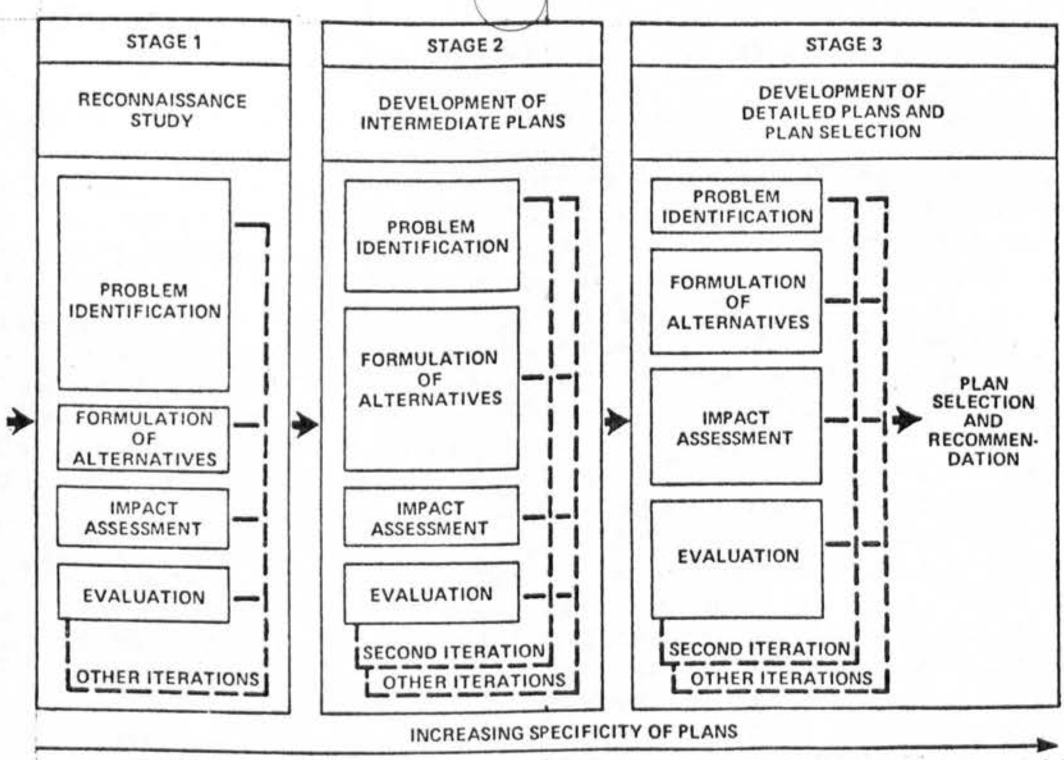

FIGURE B-1-1

PLAN DEVELOPMENT STAGES AND FUNCTIONAL PLANNING TASKS

B.1.2. In this study, however, the planning process was modified because of the extensive interagency and public involvement and the unusual combination of pre-authorization scope studies with post-authorization studies.

Study History

B.1.3. The study history portrays the progression of the public involvement influences and the subsequent effects on the planning process.

B.1.4. This study of the Atchafalaya Basin Floodway System was propagated by three congressional authorities:

- A 1968 resolution by the Committee on Public Works of the US Senate for a study of the operation of the Old River project

- Resolutions by both the US Senate and House of Representatives Committees on Public Works in 1972 for developing a comprehensive plan for the preservation and management of the water and land resources of the Atchafalaya Basin.

Authorities are stated verbatim in Appendix A.

B.1.5. In 1968, while implementing a previously authorized project feature, dredging the main channel, it was found that completion could not be effected because of a lack of funding. Subsequently, the work was blocked because there was no environmental impact statement (EIS) for the project. In 1971, the Chief of Engineers reached an agreement with the National Wildlife Federation (NWF) to cease dredging of the main channel until an EIS for the project was filed with the Council on Environmental Quality. In turn, the NWF agreed not to file any objection to work on other project features while the EIS was being prepared. Further, the NWF agreed to assist in the preparation of the EIS to bring an "environmental awareness" to the effort.

B.1.6. Throughout the course of the study, many informal meetings and field investigations were conducted for the purpose of fully coordinating with all interests; determining problems, needs, and opportunities; and assessing the impacts of alternate plans. In addition to these informal meetings, formal public meetings were held to determine the desires of local interests. Meetings were held in Morgan City, Louisiana, on 30 March 1950; Jonesville, Louisiana, on 2 October 1953; Monroe, Louisiana, on 19 April 1955; New Orleans, Louisiana, on 25 April 1955; Krotz Springs, Louisiana, on 26 April 1955; Plaquemine, Louisiana, on 6 September 1955; Port Allen,

Louisiana, on 7 November 1962; Morgan City, Louisiana, on 17 October 1964, and again on 28 September 1966; Vidalia, Louisiana, on 21 November 1968; Lafayette, Louisiana, on 19 December 1968; New Orleans, Louisiana, on 19 December 1968; Morgan City, Louisiana, on 15 October 1971; and Lafayette, Louisiana, on 25 January 1975. Generally, the comments received at these meetings were in favor of flood control both from protection and development potential standpoints. Requests stated the completion of authorized projects should be expedited. Sportsmen and environmentalists expressed that their purposes were not to oppose flood control but to protect and preserve fish, wildlife, and recreation resources.

B.1.7. In January 1972, a task force approach, in the form of a Steering Group, was initiated to manage studies for an EIS on the Atchafalaya Basin Floodway project. The Steering Group was chaired by the Corps of Engineers, with membership including representatives of the NWF; the Louisiana Department of Transportation and Development, Office of Public Works (OPW); the Louisiana Wildlife and Fisheries Commission; the US Department of the Interior, represented by the US Fish and Wildlife Service (USFWS); the US Environmental Protection Agency (EPA); and the Louisiana State University, School of Environmental Design. In 1974, a preliminary draft EIS was completed, and in January 1975, a public meeting was held to discuss the document. Following that meeting, the Steering Group developed a conceptual multipurpose plan for the Lower Atchafalaya Basin Floodway. No details were given on how the plan would or could be implemented. The Corps of Engineers began addressing the multipurpose plan under preauthorization authorities while preparing the draft EIS for the Lower Atchafalaya Basin Floodway project in a separate effort. At this point, the studies were generally of reconnaissance scope and analagous to stage 1 study effort.

B.1.8. In February 1976, a draft EIS was completed and forwarded to the Office of the Secretary of the Army. Prior to public release, the Assistant Secretary of the Army for Civil Works, after meeting with national and local interests primarily concerned with conservation and wildlife, decided not to release the draft document. As a result of that decision, the Director of Civil Works of the Office of the Chief of Engineers (OCE) authorized post-authorization studies to address both the features of the floodway project and potential features for resource preservation and management. This directive, in effect, combined the studies.

B.1.9. The studies, having been combined, entered the intermediate planning stage with a reiteration of the four functional planning tasks under the management of the Agency Management Group. This group was headed by the District Engineer, New Orleans District, Corps of Engineers, and was comprised of the EPA, represented by both its Region VI office in Dallas, Texas, and the Environmental Monitoring and Support Laboratory in Las Vegas, Nevada; the US Department of the

Interior, represented by the USFWS offices in Lafayette, Louisiana, and Jackson, Mississippi; and the State of Louisiana, represented by the Department of Transportation and Development, OPW. The Corps of Engineers had the responsibility of coordinating the study; conducting engineering, socioeconomic, and environmental studies; consolidating information from other agencies and interested parties; and preparing the report. The USFWS conducted fish and wildlife studies, assisted in formulating alternative plans, and aided in assessment of the fish and wildlife impacts of the various alternatives in accordance with the Fish and Wildlife Coordination Act. The EPA conducted a number of hydrologic and hydraulic studies, assisted in formulating plans, and aided in assessment of the impacts of the alternatives on water quality. The State of Louisiana particIpted in all facets of the study and assisted in plan formulation. Other interests, including landowner representatives, hunting clubs, the National Marine Fisheries Service, and the NWF participated in the study in an advisory role. Group efforts emphasized the development of alternative features and the formulation of preliminary plans. In January 1979, these plans were presented to the public. Meetings were held in five Louisiana cities (Baton Rouge, Jonesville, New Orleans, Lafayette, and Morgan City) to present 10 comprehensive plans, developed by the Agency Management Group from a large array of alternative features, for public comment. Attendance at these meetings was more than 5,000. Afterwards, approximately 25,000 comments were received. The primary focus of those meetings was the issue of Federal acquisition of privately-owned lands in the Atchafalaya Basin Floodway for the establishment of the "Atchafalaya Fish, Wildlife, and Multi-Use Area," as proposed independently by the USFWS. On 27-28 March 1980, and again on 17 November 1980, representatives of environmental organizations, hunting clubs, the oil and gas industry, the League of Women Voters, public hunting organizations, landowner associations, sport fishing clubs, commercial fishing interests, agricultural interests, timber interests, and minority groups were invited to attend formal Agency Management Group meetings for the purpose of keeping their respective constituents informed about the status of Atchafalaya Basin study planning efforts. National level interagency meetings were held in Washington, DC, in November 1979, April 1980, and November 1980, for the purpose of discussing the status of studies on the Atchafalaya Basin. These meetings were attended by representatives of all Federal agencies having an interest in the studies. National officers of several environmental organizations also attended, along with State of Louisiana officials.

B.1.10. In a letter dated 5 November 1980, the Governor of Louisiana submitted land use recommendations for consideration in formulating the plans to be included in the draft report. A copy of this letter with inclosures is attached for reference at the end of this appendix.

B.1.11. The study then progressed through preparation of a draft report which was presented at a series of five public meetings in

July 1981. Subsequent sections of this appendix present results of the study effort, including the Tentatively Selected Plan presented at these meetings. Public reaction and some compromises among landowners, environmentalists, and the state, along with some changes due to refinement of analyses and data, have resulted in modification of the Tentatively Selected Plan. These modifications led to the formulation of the final Recommended Plan discussed in this report.

Section 2 - FORMULATION OF PRELIMINARY PLANS

B.2.1. The paramount result of any plan for the Atchafalaya Basin is that it must satisfy the preeminent purpose of flood control. However, since the basin is one of the largest river-overflow swamp ecosystems remaining in the United States, consideration must also be given to the preservation and enhancement of the natural resources existing there. A broad range of features was available to achieve the desired conditions, and a variety of public interests have been expressed regarding the future of the area. In order to address all the pertinent concerns, singular features that are responsive to individual problems, needs, and opportunities in the study area were proposed and combined with each other in various arrays to formulate plans for evaluation.

B.2.2. Management measures which satisfied either or both of the major study goals were proposed for consideration. Those options which address the flood control aspects of the study included measures to:

- Regulate the distribution of combined flows from the Red and Mississippi Rivers between the Mississippi and Atchafalaya Rivers with the Old River control structure

- Safely pass one-half the project flood through the Atchafalaya Basin Floodway system and its outlets to the Gulf of Mexico

- Reserve real estate interests required to preclude interference with floodway operation

- Control distribution and deposition of sediment

- Reduce damages east of the floodway due to backwater flooding from the Lower Atchafalaya River.

A no-action plan was contemplated; but because of the past commitment to the current floodway system, a true no-action plan is not feasible for the Atchafalaya Basin Floodway.

B.2.3. Management options weighed for dealing with environmental protection goals were:

- Minimization of environmental impacts of flood control features

- Utilization of management units to control water levels and circulation in hydrologically discrete, environmentally productive areas within the basin to propagate fish and wildlife resources

- Acquisition of real estate interests to protect and preserve fish and wildlife habitats and to improve public access

- Implementation of sediment control measures

- Effecting means suitable for protection of coastal marshes and enhancement of the delta-building process in Atchafalaya Bay

- No action.

Alternative Measures

B.2.4. Management measures previously discussed outlined the options possible for accomplishing the objectives set for the Atchafalaya Basin. These potential measures were categorized into groups of alternatives according to geographic area and/or function so that some basis for comparison of proposed actions could be established. The eight groups of measures to be studied were as follows:

- Group I - Alternatives for Operation of the Old River Control Structure

- Group II - Alternatives for Atchafalaya Basin Main Channel Development and Levee Raising

- Group III - Alternatives for Sediment Control

- Group IV - Management Units and Related Features

- Group V - Alternatives for Floodway Land Use

- Group VI - Alternatives for Floodway Outlets and Delta Building

- Group VII - Alternatives for Reducing Backwater Flooding Esat of Floodway

- Group VIII - Management Entity.

Specific features for effecting the objective results were explored for each of the major groups of management measures listed and are described in the following paragraphs of this section.

GROUP I - ALTERNATIVES FOR OPERATION OF OLD RIVER CONTROL STRUCTURE

B.2.5. Maintain a 70/30-Percent Distribution of Total Flows Between the Mississippi and Atchafalaya Rivers Below Old River, Respectively (Current Operation). This feature provides for operation of the Old River control structure to maintain the approximate distribution of flows between the Mississippi and Atchafalaya Rivers that was observed in 1950. The total flows of the Red River and the Mississippi River above the Old River project are distributed so that 70 percent of the combined flows moves via the Mississippi River below Old River and 30 percent moves via the Atchafalaya River. This flow distribution is currently maintained on an annual basis.

B.2.6. Maintain Current Operation with Provisions for Short Term Variation During May, June, and July. Various interest groups have expressed a desire for this distribution to be modified slightly. For example, farmers in the Red River backwater area would benefit during some years in the months of May, June, and July from a reduction of flow into the Atchafalaya River that would limit the stages at Acme, Louisiana, to 45 feet National Geodetic Vertical Datum (NGVD)[1/]. However, the USFWS would like flows increased during the same months in some drier years to benefit fishery resources in the lower floodway. Short term changes in flow distribution could be considered when such changes can be accomplished without adversely impacting other resource uses. Operational procedures would be reviewed to determine the advisability of developing specific criteria for such changes. The new auxiliary control structure at Old River (begun in July 1981) will serve to insure the integrity of the existing system and will maintain the existing operational conditions.

B.2.7. Operate Old River Control Structure to Keep Water Levels from Rising Above 35 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. With this feature, flow through the Old River low sill control structure would be reduced as necessary to prevent stages on the Black River at Acme, Louisiana (in the Red River backwater area), from exceeding 35 feet NGVD. Two constraints preventing this stage from being maintained each year are the differential head between the forebay and the tailbay of the low sill control

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[1/] Unless noted otherwise, all elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD), formerly mean sea level.

structure cannot exceed 20 feet, and operation of the Morganza or Bonnet Carre floodways cannot be induced by the alternative. When stages on the Black River at Acme, Louisiana, are 35 feet NGVD or less, the 70/30 distribution of flows would be maintained.

B.2.8. Operate Old River Control Structure to Keep Water Levels from Rising above 40 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. This feature is identical to the preceding one, except stages at Acme would be limited to 40 feet in lieu of 35 feet.

B.2.9. Operate Old River Control Structure to Keep Water Levels from Rising Above 45 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area. This feature is identical to the 30 feet at Acme option, except stages would be limited to 45 feet in lieu of 30 feet.

B.2.10. Operate Old River Control Structure to Maintain 35 Feet NGVD at Black River at Acme, Louisiana, in the Red River Backwater Area with No Head Constraints. Under this proposal, flows through Old River control structure would be reduced as necessary to prevent stages on the Black River at Acme, Louisiana, from exceeding 35 feet NGVD. The differential head constraint at the low sill control structure would not be applicable because a new replacement structure would be installed. However, the constraint of not inducing an operation of the Morganza or Bonnet Carre floodways would still be appropriate. When stages on the Black River at Acme, Louisiana, are 35 feet NGVD or less, the 70/30 distribution of flows would be maintained.

B.2.11. Operate Old River Control Structure to Maintain 65/35-Percent Distribution of Total Flows Between the Mississippi River Below Old River and the Atchafalaya River, Respectively. In addition to the constraints described in previous paragraphs, this alternative feature would require flows in the Mississippi River below Old River be a minimum of 300,000 cubic feet per second (cfs) to limit the point of saltwater intrusion from the Gulf of Mexico to Head of Passes because of the impacts on drinking water supplies.

B.2.12. Operate Old River Control Structure to Maintain 60/40-Percent Distribution of Total Flows Between the Mississippi and Atchafalaya Rivers Below Old River, Respectively. Under this option, flows through the Old River control structure would be increased to maintain a 60/40-percent distribution between the Mississippi River below Old River and the Atchafalaya River, respectively. A new replacement structure would be required for normal flows. As with the previous feature, flows in the Mississippi River below Old River must be maintained above 300,000 cfs to minimize saltwater intrusion.

GROUP II - ALTERNATIVES FOR ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT AND LEVEE RAISING

B.2.13. Raise the Floodway Levees Only. The Atchafalaya Basin protection levees and associated structures would be raised to confine project floodflows, and no measures would be taken to further accelerate the development of the Atchafalaya Basin main channel. The construction of other authorized project features, exclusive of the Sherburne and Courtableau freshwater structures and the incomplete boat-launching ramps, would be continued. All subsequent options for main channel development recognize that the East and West Atchafalaya Basin Protection Levees will continue to be raised, as necessary, in combination with the main channel development feature, to safely pass the project flood. Also included in all structural plans is the installation of bank protection measures on the Atchafalaya River above river mile 55.

B.2.14. Dredge a 100,000-Square Foot (sf) Main Channel. With this feature the Atchafalaya Basin main channel would be dredged to accelerate its development to 100,000 sf below the 1963 datum plane between the head of Whiskey Bay Pilot Channel and Wax Lake Outlet (mile 54.5 to mile 105.0), and to 80,000 sf below the 1963 datum plane between Wax Lake Outlet and Stouts Pass (mile 105.0 to mile 112.3). Gaps would be left in the dredged material.

B.2.15. Dredge a Confined 100,000-sf Main Channel. This feature is the same as the preceding one, except that no gaps would be left in the dredged material.

B.2.16. Dredge an 80,000-sf Main Channel. Under this option, the Atchafalaya Basin main channel would be dredged to 80,000 sf below the 1963 datum plane between the head of Whiskey Bay Pilot Channel and Wax Lake Outlet (mile 54.5 to mile 105.0) and 60,000 sf between Wax Lake Outlet and Stouts Pass (mile 105.0 to mile 112.3).

B.2.17. Train the Main Channel. To effect this alternative feature, material would be dredged from the Atchafalaya Basin main channel and deposited within diked disposal areas on its banks to a height sufficient to confine average annual high water. Variations of this feature would confine only lesser floods within the banks of the main channel.

GROUP III - ALTERNATIVES FOR SEDIMENT CONTROL

B.2.18. Realine Distributary Channels. The realinement of the major distributary channels of the Atchafalaya Basin main channel would be made to effect a reduction in deposition of bedload sediments to the distributary. These realinements would be constructed at the major

distributary channels: the Old Atchafalaya River, the east and west access channels, and the east freshwater distribution channel. Any combination of these realinements could be combined with any one of the other groups of alternatives in a comprehensive plan.

B.2.19. Construct Distributary Sediment Traps. This proposal would provide sediment traps; i.e., enlarged channel sections to reduce flow velocities near the heads of major distributary channels. These enlargements would act as settling basins, thereby trapping sediments. The sediment traps would be maintained by annual dredging. Sediment traps could be constructed at any of the distributaries with or without distributary realinements and/or in conjunction with any one of the preceding groups of alternative features.

GROUP IV - MANAGEMENT UNITS AND RELATED FEATURES

B.2.20. Natural processes and human actions have combined to produce distinct environmental and hydrological subdivisions within the Lower Atchafalaya Basin Floodway. These areas have been identified as management units for the purposes of this study (see Figure B-2-1) so that it may be possible to formulate water management plans to retain or restore unique environmental values of an individual area. Engineering and environmental feasibility for effecting the desired conditions within each unit would be determined by subsequent detailed studies. Proposed actions would achieve the following:

- Restoration of water regimes to approximate, as closely as practicable, historical overflow patterns

- Regulation of water circulation through the units to benefit specific habitats of the unit

- Restriction of sediment movement and deposition within the units

- Continued transportation of nutrients and organic matter to estuarine areas and the Gulf of Mexico.

B.2.21. Each management unit would be individually evaluated to determine the potential for successfully retaining or restoring desirable environmental values. Some preliminary proposals investigated early in the study process are described in Appendix C.

B.2.22. Alternatives to Management Unit Plans. An alternative to each of the management unit concepts described in Appendix C was a plan by which each unit would have controlled inlets and outlets, lock, and pumping stations. These alternatives were eliminated from further consideration because preliminary estimates indicated that

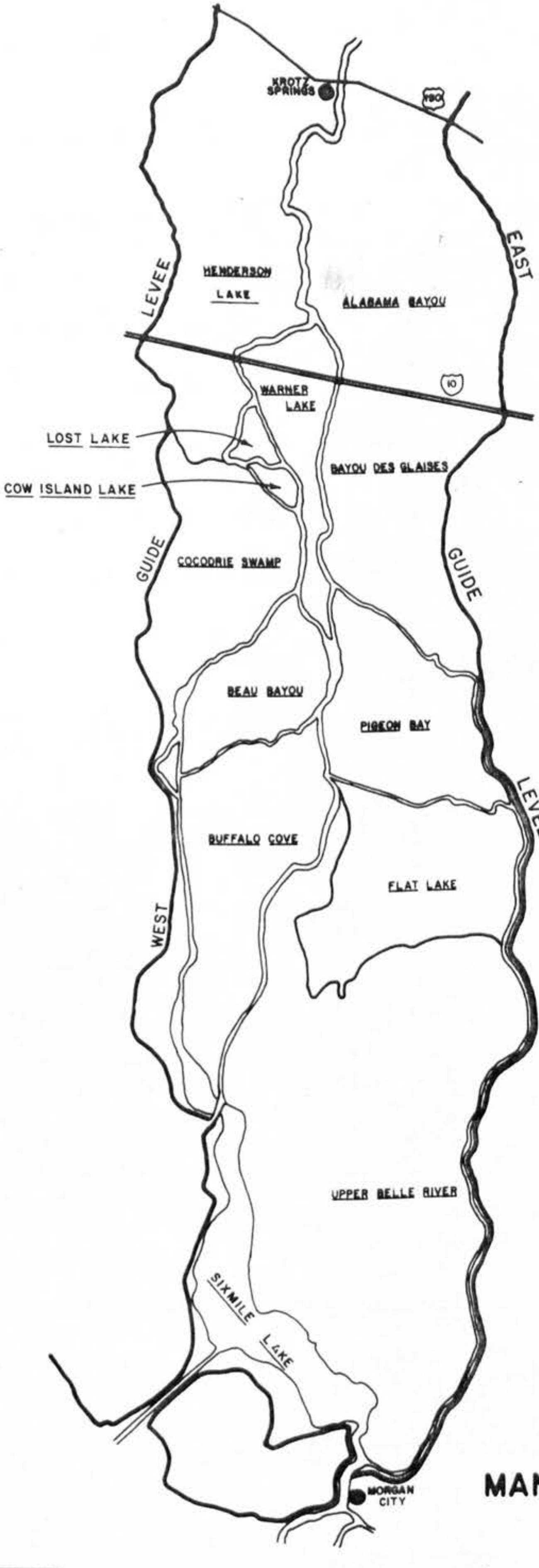

FIGURE B-2-1

MANAGEMENT UNITS

construction, operation and maintenance costs would be far greater than with other alternatives.

B.2.23. Freshwater Structures. The Courtableau Freshwater Diversion Structure to be placed at Atchafalaya River mile 48 would serve as an inlet through the river levee for the Henderson Lake management unit area. This structure would be a gated culvert designed to pass 3,000 cfs into Bayou Courtableau. The Sherburne Freshwater Diversion Structure at river mile 43 would provide freshwater through the river levee to the Alabama Bayou area. This gated culvert would pass 3,000 cfs into Big Alabama Bayou.

B.2.24. Canal Closures and Circulation Improvements. This feature would consist of closing certain canals that permit sediment-laden waters to enter backswamp areas and of improving water circulation throughout the lower floodway by selective opening of dredged material banks and other features that presently impede beneficial circulation.

GROUP V - ALTERNATIVES FOR FLOODWAY LAND USE

B.2.25. No Action. No additional real estate interests would be acquired.

B.2.26. Fee Acquisition. The Federal Government would purchase all surface rights to all lands in private ownership in the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs, Louisiana.

B.2.27. Comprehensive Multipurpose Easement: Government Controls Timber and Access. This easement would allow the Federal Government to overflow lands in the Lower Atchafalaya Basin Floodway for any purpose, for any length of time, either naturally or artificially; to construct recreational facilities; to regulate public access; to forbid construction of permanently habitable structures; to forbid or regulate the construction of other structures, including camps; to forbid removal of timber; to forbid the use of lands for agricultural purposes; and to regulate excavation and landfill operations. Landowners would retain mineral rights. These easements would be acquired over all lands in private ownership within the Lower Atchafalaya Basin Floodway below the approximate latitude of Krotz Springs.

B.2.28. Comprehensive Easement: Landowner Controls Timber, Government Controls Access. This interest would be similar to the preceding feature, except the landowner could pursue good commercial timber practice on a sustained yield basis.

B.2.29. Comprehensive Easement: Landowner Controls Timber and Access. This would be similar to the preceding options, except the landowner would also control access.

B.2.30. In addition to the easement interests cited, several combinations of the individual features of these alternatives were evaluated.

GROUP VI - ALTERNATIVES FOR FLOODWAY OUTLETS AND DELTA BUILDING

B.2.31. Construct Levees Only. Levees, floodwalls, and other associated structures would be raised to confine project floodflows to the Lower Atchafalaya River and Wax Lake Outlet. The combined capacity of the floodway outlets to pass floodflows would be allowed to continue to decrease.

B.2.32. Construct a New Floodway Outlet Near Charenton. A new overbank floodway outlet would be constructed near Charenton, Louisiana, to provide additional capacity for floodflows. The design capacity of the overbank floodway outlet would be 250,000 cfs. The frequency of operation would average once each 50 years. A gated control structure would control inflows to the outlet. Other associated structures would provide for drainage intercepted by the new levees. Levees, floodwalls, and other associated structures would be raised to confine remaining floodflows to the Lower Atchafalaya River and Wax Lake Outlet. Back levees along Bayou Teche would be raised to prevent backwater flooding.

B.2.33. Widen Wax Lake Outlet Overbank. A new levee would be constructed west of the levee along the west side of Wax Lake Outlet near the Bayou Sale ridge to form a new overbank floodway outlet. The existing levee would be degraded to ground level. The added overbank area would increase the share of project floodflows passing through the Wax Lake Outlet. Levees, floodwalls, and other associated structures would be raised to confine remaining flows to the Lower Atchafalaya River and Wax Lake Outlet.

B.2.34. Construct a New Overbank Outlet East of the Floodway. This proposal would provide for a new overbank floodway outlet, extending from the East Atchafalaya Basin Protection Levee immediately north of Morgan City, Louisiana, across the Bayou Boeuf ridge to the Atchafalaya Bay. The design capacity of the new outlet would be 250,000 cfs; the frequency of operation would average once every 50 years. Canals and associated structures would provide for intercepted drainage when the floodway is in operation. Levees, floodwalls, and other associated structures would be raised to confine remaining outlet floodflows to Wax Lake Outlet and the Lower Atchafalaya River.

B.2.35. Redistribute Major Flows to Wax Lake Outlet. To accomplish this proposal, Wax Lake Outlet would be enlarged by dredging to increase its flow capacity, and a navigation lock and control structure would be constructed upstream of the Lower Atchafalaya River. Levees, floodwalls, and associated structures would be raised

to confine floodflows to the Lower Atchafalaya River and Wax Lake Outlet. Back levees along the Bayou Sale ridge would be raised to prevent backwater flooding.

B.2.36. Close Wax Lake Outlet to Normal Flows. A closure of the existing Wax Lake channel and a low-level levee would be constructed upstream of Wax Lake Outlet to close the outlet to normal flows. The low-level levee would act as a weir and would be overtopped on the average of once every 10 years. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the Lower Atchafalaya River and Wax Lake Outlet.

B.2.37. Maintain Existing Flow Distribution. A weir and low-lying levee would be constructed upstream of Wax Lake Outlet to maintain approximately the existing distribution of flows, 70 percent to the Lower Atchafalaya River and 30 percent to Wax Lake Outlet. The weir would operate at all times and the low-level levee would be overtopped as described in the preceding feature. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the outlets.

B.2.38. Restore Approved Design Flow Distribution. This feature is similar to that described in the preceding paragraph, except that the weir and low-lying levee could be designed to restore the distribution of flows between the two outlets that Wax Lake Outlet was designed for, i.e., 80 percent to the Lower Atchafalaya River and 20 percent to Wax Lake Outlet. Levees, floodwalls, and associated structures would be raised to confine project floodflows to the two outlets.

B.2.39. Construct Channel Training Works Below Morgan City. Channel training could be accomplished by closing Bayou Shaffer, a distributary of the Atchafalaya River, with an earthen dam. The development of the banks of the Lower Atchafalaya River and Wax Lake Outlet channel would be accelerated by dredging channel bottoms and using the material to construct shallow mounds designed to simulate the development of natural levees. Other distributaries would not be closed.

GROUP VII - ALTERNATIVES TO REDUCE BACKWATER FLOODING EAST OF THE FLOODWAY

B.2.40. The backwater area is delineated on Plate B-2.

B.2.41. Construct Bayou Boeuf Levee - Morgan City to Houma. With this plan, a new levee would be constructed from the Bayou Boeuf lock along Bayou Boeuf and Bayou Black, a distance of approximately 30 miles. Navigable floodgates would be provided where the levee crossed Bayous Boeuf and Black. Pumping facilities would be provided to remove all intercepted natural drainage from the backwater area.

B.2.42. Limited Structural Measures. These alternatives for protection of only the developed parts of the backwater area east of the floodway would consist of construction of ring levees and drainage pumping stations. One option would use two ring levees to protect the Morgan City-Amelia and Bayou Black industrial areas. Navigation structures in Bayou Chene just below Bayou Boeuf, on Bayou Boeuf just below Lake Palourde, and two on Bayou Black would be required. These structures would be closed when water elevations begin flooding the area. To provide for drainage of the runoff from the backwater area above Morgan City, a bypass east of and equivalent in size to Bayou Boeuf would be required. A second proposal would use 28 ring levees with pumping stations for interior drainage to protect the same industrial areas, as well as various populated areas within the backwater area (Plates B-3, B-4, and B-5). Such ring levees would provide protection within the ringed areas from backwater flooding, as well as headwater and tidal flooding. However, the construction right-of-way for ring levee alinements would require the relocation of about 1,900 existing residential, commercial, and public structures that are located along bayous or in other physically restricted areas. Further, all structures located outside the ring levees would require raising, flood-proofing, or removal for prevention of flood damages. Additionally, this alternative would not offer protection for roads nor most existing farmlands that are subject to backwater flooding.

B.2.43. Extension of Avoca Island Levee. The Avoca Island levee would be incrementally extended to a total length of either 17.0 or 19.6 miles, depending upon the levee alinement selected (see Plate B-6). The existing Avoca Island levee was constructed to limit project flood stages east of Morgan City to generally the same stages that occurred in that area in the 1945 flood. The amount of flooding from backwater is related to the stage in the Lower Atchafalaya River at the end of the Avoca Island levee. Since the active development of the delta in Atchafalaya Bay will result in elongation of the course of the river and raise the stage at the end of the existing levee for a given discharge, flooding in the backwater area would occur more frequently in the future. Depths of floodwater would also increase as time goes on. Thus, this feature would provide phased implementation of additional levee reaches as necessary to maintain stages for each reach equivalent to the 1945 backwater conditions. Two alinements were proposed for the levee extension, one following the navigation channel through Atchafalaya Bay and the other basically paralleling the eastern shore of the bay. Levee extensions would be accompanied by extensions of the Avoca Island cutoff channel around the end of each reach to provide for navigation. The bayshore alinement, totaling 19.6 miles in length, would require some type of navigation structure in the levee, since it would be infeasible to extend the cutoff channel around the end of the levee and across the bay to the Lower Atchafalaya River channel for each reach of the levee extension. Because the marsh in Terrebonne Parish east of the Avoca Island levee depends upon freshwater and sediment from the Lower

Atchafalaya River to prevent saltwater intrusion and compensate for marsh subsidence, a freshwater diversion structure or structures would be included in the levee extension to divert flow from the river to the marshes. The structure(s) would be designed to maintain the present distribution of flow, estimated to be 4,000 cfs, into the west Terrebonne Parish marsh and would be closed when the stage at Amelia, Louisiana, reaches 3.0 feet NGVD to provide protection from Lower Atchafalaya River backwater.

B.2.44. <u>Extension of Avoca Island Levee 14,000 Feet</u>. The Avoca Island levee would be extended by 14,000 feet to continue backwater flooding protection in the area east of the floodway for a period of about 10 years. This action would provide an interim period of protection to allow for completion of detailed studies of the Atchafalaya Bay-Terrebonne Parish marsh-backwater complex. A freshwater diversion structure, identical in both design and operation to that described under <u>Extention of Avoca Island Levee</u>, would also be provided for this interim protection alternative.

GROUP VIII - MANAGEMENT ENTITY

B.2.45. <u>Management Entity</u>. To insure the proper implementation and operation of the plan selected, a management entity comprised of the Corps of Engineers, USFWS, EPA, and the State of Louisiana would be established. Mechanisms would be included for public involvement. Emergency flood control operations would be conducted as required by the Corps of Engineers, with or without the concurrence of the management group.

Plan Formulation

B.2.46. As each of these major groups of alternative measures was, to some extent, interrelated with each of the other groups, an extremely large number of combinations of alternative features was possible. Since survey scope evaluation of the economic, environmental, and social aspects of each possible combination was impracticable, it was necessary to limit the number of combinations of alternative features to be considered. Thus, a number of plans, which were deemed representative of the spectrum of actions being studied, were selected and analyzed with respect to their relative economic and environmental benefits and anticipated adverse impacts. The results of these analyses, presented in subsequent paragraphs, and the inputs from the January 1979 public meetings provided a basis for eliminating a number of alternative features.

B.2.47. Analysis of the preliminary plans presented at the 1979 public meetings began with a compilation of existing data, including land and water use inventories, biological inventories, hydraulic and hydrologic data for present and alternate future conditions, and engineering cost estimates. Using these data and methods for predicting vegetative succession developed by an interagency interdisciplinary group of biologists, forestry experts, agricultural economists, and engineers, land use changes were estimated at 10-year increments for the period 1978-2029. To provide a common base for evaluation, all projections assumed immediate project implementation.

B.2.48. Except for conversion of bottomland hardwoods to cleared land, all other land changes in the Red River backwater area, upper floodways, and areas outside the floodway system were assumed to be constant for all plans. Hydrologic changes were assumed to occur at a constant rate (straight line) over the project life. Monetary and nonmonetary benefits and losses associated with the changes in land use resulting from each of the plans were determined by land type over time. Monetary values included commercial finfishing, commercial crustucean production, commercial fur trapping, timber resources, recreation resources, and agricultural production. Commercial fishing and fur trapping production was estimated by using the "1971-1974 Atchafalaya Basin Usage Study," prepared cooperatively by the New Orleans District and Louisiana Department of Wildlife and Fisheries. Values were assigned to the production figures by using National Marine Fisheries Service data. Recreation values were assessed by first determining demand. After consultation with the Heritage Conservation and Recreation Service (formerly Bureau of Outdoor Recreation), demand was established jointly by New Orleans District and State of Louisiana, Department of Culture, Recreation and Tourism, Office of Program Development recreation planners. Land use projections were used to determine supply. "Principles and Standards" values were assigned to the computed man-day deficits. Timber and agricultural values were determined from field investigations performed by New Orleans District economists. Finally, all values were adjusted to present value, using an interest rate of 6 7/8 percent, and amortized over the life of the project so that all data were based on average annual equivalents.

B.2.49. The nonmonetary analyses consisted of using habitat values previously determined by New Orleans District, USFWS, and Louisiana Department of Wildlife and Fisheries biologists for the USFWS Habitat Evaluation Procedure (HEP). A method similar to HEP was used to determine average annual habitat value differences associated with the various plans.

B.2.50. The discussion that follows reflects relative differences in plans. These differences were assumed to result from conversion of bottomland hardwoods, and direct land use changes resulting from project works.

EVALUATION OF OLD RIVER ALTERNATIVES

B.2.51. Information on the evaluation of the national economic development (NED) and the environmental quality (EQ) components of the alternative plans for operating the Old River, Louisiana, project is summarized below. The modification of the operation of the Old River, Louisiana, project to redistribute flows between the Mississippi River and the Atchafalaya River, and the direct and indirect physical changes that would be effected by such redistributions would have significant economic and environmental impacts throughout the study area. The cost of completing the Mississippi River mainline levees below Old River and the cost of completing the Atchafalaya Basin Floodway project would be significantly affected. In some cases the cost of modifying the Old River project to accommodate the modified flow distribution would be significant. Development (mostly agriculture) in the Red River backwater area and the Lower Atchafalaya Basin Floodway would be affected, as would fish and wildlife resources and recreation. Commercial fishing and trapping in the Lower Atchafalaya Basin Floodway would be affected by some of the alternatives. These effects are discussed subsequently in more detail.

B.2.52. NED Effects on the Mississippi River Mainline Levees. The mainline Mississippi River levees below Old River have not been completed to the project flood grade. If average annual flows in the Mississippi River below Old River were increased, scouring of the Mississippi channel would occur, effecting an increase in the bankful capacity of the river and a corresponding drop in the project flood flowline. For a decrease in average annual flows, the Mississippi River channel would fill in and the project flood flowline would rise. Because of the time frame during which scouring of the Mississippi River channel would occur, interim protection would be provided to the present project flowline. Additional costs of completing the Mississippi River levees would be incurred only if more than 30 percent of the flows were passed down the Atchafalaya.

B.2.53. NED Effects in the Atchafalaya Basin Floodway. The redistribution of average annual flows between the Mississippi and Atchafalaya Rivers would also affect the rate of development and the ultimate size of the Atchafalaya River and its main channel. The flood-carrying capacity of the Atchafalaya Basin main channel would be increased by those alternatives that increase average annual flows to the Atchafalaya River and would be decreased by those alternatives that decrease flows to the Atchafalaya River. A corresponding change in project flood flowlines for the Atchafalaya Basin Floodway would be effected. Thus, in terms of costs to complete the Atchafalaya Basin Floodway project, the Old River alternatives that reduced flow down the Atchafalaya showed slightly higher costs than a 70/30 distribution. Alternatives that increased the percentage of flows down the Atchafalaya were substantially cheaper than the 70/30 distribution.

* B.2.54. NED Effects on Old River Project. To provide redistribution of flows proposed by some alternatives considered at Old River, structure modifications or replacement would have been required. For example, a replacement structure, costing an estimated $220 million in
* 1978, would be necessary had the 35 feet NGVD at Acme (No Head Restriction) or the 60/40-Percent Distribution alternatives been recommended. However, the auxiliary structure (currently under construction) satisfies the requirements of the other Old River alternatives at a cost lower than the replacement structure; and
* therefore, significant savings were realized.

B.2.55. NED Effects on Development in Red River Backwater Area and Atchafalaya Basin Floodway. A change in operation of the Old River project would affect the overflow regime in the Red River backwater area. If less water were passed down the Atchafalaya River, less flood damages to agriculture and other development would occur, the agricultural yields from cleared lands and the amount of land that could be converted from woodland to agriculture would increase substantially. On the other hand, plans that would increase flows through Old River would cause substantial agricultural losses compared to a 70/30 distribution.

B.2.56. The 35-, 40-, and 45-foot at Acme plans would result in greater agricultural development within the Lower Atchafalaya Basin Floodway; however, they would also cause substantial fish and wildlife losses. Generally, the 65/35 distribution plans would result in short term gains for fish and wildlife values, but would result in a net loss over the project life. This is because these alternatives for Old River operation would cause a greater amount of main channel development over the long term.

B.2.57. EQ Effects on the Mississippi Mainline Levee. Small additional acreage would be required to raise the levees if more water were passed through Old River. The majority of the acreage required would be existing levee; however, a small amount would be early successional bottomland hardwoods.

B.2.58. EQ Effects on the Lower Atchafalaya Basin Floodway. Compared to maintaining a 70/30 flow, the reduction in water levels caused by the 35 feet at Acme plan would drastically reduce wildlife habitat. An average of approximately 4,000 acres would be lost each year. Large amounts of fishery habitat would also be destroyed annually.

B.2.59. It should be noted that the 65/35 plan would cause a short term rise in water levels but an ultimate drop in water levels and an increase in sedimentation over the 70/30 plan.

B.2.60. EQ Effects in Old River Project. An auxiliary structure at Old River would be necessary for all alternatives except the 35 Feet NGVD at Acme (No Head Restriction) and 60/40-Percent Distribution alternatives, which would require a replacement structure instead. The direct land and water requirements for these alternatives were not calculated but were estimated to be essentially the same.

* Revised 3/31/82

B.2.61. EQ Effects in the Red River Backwater Area. Changes in operation of the Old River project would affect the amount of land clearing that would occur in the Red River backwater area. The 35 Feet at Acme plan would cause a certain, uncalculated loss in aquatic habitat, while the 65/35 plan would preserve more aquatic habitat in the backwater area. The loss in terrestrial habitat for the 35 Feet at Acme plan would be substantial with extensive acreage being cleared each year for agricultural production.

EVALUATION OF ATCHAFALAYA BASIN MAIN CHANNEL DEVELOPMENT ALTERNATIVES

B.2.62. Information on the evaluation of the NED and the EQ components of the plans for providing project floodflow capacity in the Lower Atchafalaya Basin Floodway is summarized in the following paragraphs. Only those related to the Atchafalaya Basin main channel plans are presented here. Others will be presented later.

B.2.63. The most significant economic effects of the alternatives for providing project floodflow capacity in the floodway relate to the cost of completing the Atchafalaya Basin Floodway project. Commercial fishing and trapping, recreation, and timber resources would also be affected. The effects are discussed below.

B.2.64. NED Effects on Atchafalaya Basin Floodway Project. Measures to accelerate the development of the Atchafalaya Basin main channel would also effect a reduction in sedimentation. The difference is in the amount of sedimentation that would occur while the main channel is developing. For the purpose of evaluating the effects of each of the feature options for developing the main channel, four alternative combination flowlines were run and costs analyzed. These were for the 100,000-sf main channel, the 80,000-sf main channel, channel training on the main channel, and levees only. For comparing each of these schemes, both the Old River distribution and the outlets distribution were taken to be 70/30. This group of alternatives demonstrated the relationship between the cost of raising levees, floodwalls, and other structures to confine project floodflows and the cost of acceleration of main channel development. Preliminary cost estimates indicated that the 80,000-sf channel alternative would have the highest first costs because of the higher flowline and associated levee raising costs.

B.2.65. Other NED Considerations. The main channel alternatives also effect a redistribution in habitat types by affecting the ultimate amount of sedimentation that will occur in the floodway overbank areas and the suitability of the land for development. This, in turn, would affect commercial fishing and trapping, recreation, timber, and agricultural resources in the floodway. Preliminary estimates indicated that, compared to levee raising, channel training would reduce recrea-

tional, commercial fishing and trapping, and timber revenues, but would at the same time slightly increase agricultural revenues. The 100,000-sf channel would double the above losses. Agricultural revenues would be six times those with channel training but would not equal the environmental losses.

B.2.66. EQ Effects on Atchafalaya Basin Floodway Project. Preliminary estimates indicated that 16,000 acres of forestland would be necessary for channel training and in excess of 20,000 acres for the 100,000-sf channel. Habitat values in the future would decrease drastically with the 100,000-sf channel due to the clearing for agriculture that would occur with this plan.

EVALUATION OF FLOODWAY LAND USE PLANS

B.2.67. NED Considerations. The primary NED effect would be the cost of acquiring easements. The acquisition of floodway lands or multipurpose easements could prohibit clearing of forestland for agricultural purposes, and the net yield from timber production would increase while agricultural yields would be reduced. The clearing restriction would increase the values for recreation and commercial fishing and trapping, and preserve more areas for these uses. The yearly agricultural losses due to easements would be four times greater than environmental gains.

B.2.68. EQ Considerations. Acquisition of floodway lands or multipurpose easements could preserve thousands of acres of fish and wildlife habitat that would otherwise be lost due to clearing for agriculture.

EVALUATION OF FLOODWAY OUTLETS PLANS

B.2.69. Information on the alternative plans for passing floodflows from the Lower Atchafalaya Basin Floodway are discussed below. These plans have significant effects on the cost of completing the Atchafalaya Basin Floodway project. Associated with some of the plans is a redistribution of project floodflows and normal flows. These would impact on environmental and economic values of the area affected by outflows from the floodway, primarily the marsh areas near the outlets. The configuration of the new delta would also be affected by some alternatives, although the ultimate size and area-elevation relationship of the new land mass would not be significantly affected. These impacts are discussed as follows.

B.2.70. NED Effects of Outlet Plans. The outlet alternatives have a significant effect on the cost of completing the Atchafalaya Basin

Floodway. Associated with each alternative is the cost of its implementation and the savings in levee and floodwall cost. The least costly outlet alternative would be to maintain the existing 70/30 distribution, widen the Wax Lake Outlet overbank, and channel train the outlets. The most expensive alternative would be the floodway east of the channel.

B.2.71. EQ Effects of Outlet Plans. The alternative outlet plans for the floodway affect the direct land and water requirements for the completion of existing project features (by causing flowline changes) and require land and water areas for their construction. The net requirements of wetlands and total land and water varied greatly. These alternatives also affect the distribution of flows between the Lower Atchafalaya River and Wax Lake Outlet.

January 1979 Public Meetings

B.2.72. Combined with the foregoing appraisal of the effects of proposed actions, analyses of the plans developed for and the results obtained at the January 1979 public meetings provided the basis for the formulation of plans to be considered in detail. For illustrative purposes in connection with the public meetings, 10 "comprehensive plans" were assembled, each including one feature from each of the eight groups of alternatives previously discussed, to demonstrate to the public the wide array of plans that could be developed by combining features from the various groups. Plans presented gave varying degrees of emphasis to each of the goals and objectives of the study, ranging from those which were primarily for environmental protection to those which stressed economic development. An underlying constraint on the formulation of all plans was the need to provide protection from Mississippi River flooding.

B.2.73. In addition to the real estate options developed in earlier study efforts, the USFWS, in October 1978, published a brochure entitled, "The Atchafalaya, America's Greatest River Swamp," proposing the establishment of an Atchafalaya Fish, Wildlife, and Multi-Use Area. The major element of the proposal would be the purchase by the Federal Government of 445,000 acres of privately-owned land in the basin. Under their plan, the current landowners would retain the mineral rights. Management of the area acquired would be the responsibility of the US Department of the Interior and the Louisiana Department of Wildlife and Fisheries. The primary management objectives would be the preservation of the wetland character of the floodway and the guarantee of full public enjoyment of its fish, wildlife, and recreational resources. Continued use of existing camps

and dwellings would be allowed along perimeter levees and presently developed natural ridges.

Comparison of Preliminary Plans

B.2.74. The 10 preliminary plans developed for discussion at the January 1979 public meetings are shown in Table B-2-1. To evaluate and compare the plans, they were ranked from 1 through 10 according to their estimated impact on various environmental, physical, and economic factors as understood at that time. The results of that ranking are shown in Table B-2-2.

B.2.75. The following is a brief description of the impacts of each plan; these impacts were used to rank the plans by impact category. The main factors affecting the rankings were land use control, sediment controls, water levels, and direct construction requirements. Rankings were based on the relative magnitude/value of the resource usage evaluated over the project life.

B.2.76. Summary of Impacts. Major impacts of each plan are summarized as follows.

B.2.77. Plan A. This plan would significantly increase flows into the Atchafalaya Basin and the Red River backwater area. Increased flows, in combination with Federal acquisition of the basin, would insure maximum preservation of the land- and water-oriented environmental values and would provide the general public an opportunity to enjoy these benefits. In particular, commercial crawfishing, sport and commercial fishing, and trapping would be enhanced by implementation of this plan more than by any other.

B.2.78. Conversely, reducing Mississippi River flows below Old River would adversely affect navigation on the Mississippi River. The increased stages in the Red River backwater area would considerably reduce agricultural production. Similarly, increasing flows into the Atchafalaya Basin, in combination with fee acquisition, would eliminate further agricultural clearing and remove the potential income that could be realized from this activity.

B.2.79. Management units as perceived at this stage of planning would provide for optimum environmental benefits.

B.2.80. The developed area east of Morgan City would be provided with flood protection; however, undeveloped areas would continue to be subject to flooding, limiting future development potential.

TABLE B-2-1 -DESCRIPTION OF PLAN FEATURES

PLAN	GROUP I - OLD RIVER CONTROL	GROUP II - MAIN CHANNEL	GROUP III - SEDIMENT CONTROL	GROUP IV - MANAGEMENT UNITS	GROUP V - FLOODWAY REAL ESTATE PLANS	GROUP VI - FLOODWAY OUTLETS AND DELTA BUILDING	GROUP VII - BACKWATER FLOODING	GROUP VIII - MANAGEMENT ENTITY
A	60 percent Mississippi River 40 percent Atchafalaya River	Channel Training	Yes	Yes	Fee Acquisition by Government	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment distribution	Limited structural measures	Yes
B	70 percent Mississippi River 30 percent Atchafalaya River	100,000 square feet	Yes	No	Comprehensive easement Government timber and access	Lower Atchafalaya River-0 percent/Wax Lake Outlet-100 percent	Limited structural measures	Yes
C	35 feet NGVD at Acme No Head Constraint	100,000 square feet	No	No	None	Lower Atchafalaya River-100 percent/Wax Lake Outlet-0 percent	Avoca Island Levee	No
D	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	Yes	Fee Acquisition by Government	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment redistribution	Limited structural measures	Yes
E	35 feet NGVD at Acme	100,000 square feet	Yes	No	Comprehensive easement land-owner timber and access	Widen Wax Lake Outlet overbank Channel Training, Lower Atchafalaya River-100 percent/Wax Lake Outlet-0 percent	Avoca Island Levee	No
F	70 percent Mississippi River 30 percent Atchafalaya River	Confined 100,000 square feet	Yes	Yes	Comprehensive easement land-owner timber Government access	Lower Atchafalaya River-100 percent/Wax Lake Outlet- 0 percent, Widen Wax Lake Outlet overbank Channel Training	Avoca Island Levee	Yes
G	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	No	None	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent	Limited structural measures	No
H	70 percent Mississippi River 30 percent Atchafalaya River	100,000 square feet	No	No	None	Lower Atchafalaya River-80 percent/Wax Lake Outlet-20 percent	Avoca Island Levee	No
I	70 percent Mississippi River 30 percent Atchafalaya River	No action	No	No	None	No action	No action	No
J	70 percent Mississippi River 30 percent Atchafalaya River	Channel Training	Yes	Yes	Comprehensive easement Government timber and access	Lower Atchafalaya River-70 percent/Wax Lake Outlet-30 percent with sediment redistribution	Limited structural measures	Yes

TABLE B-2-2 --COMPARISON OF PLANS

Plan	Forest	Cleared Land	Water	Delta and Marsh	Land Inundated: Average of 0-4 months	Land Inundated: Average of 7 months	Accessibility to public	Crawfishing, trapping, fishing (sport and commercial), waterfowls and water quality	General recreation	Hunting	Deer, squirrels, and songbirds	Agriculture production	Timber production	Mississippi River Navigation	First cost (million $)	Annual cost (million $)
A	10	1	10	10	10	10	yes	10	10	6	5	1	7	2	775	65.3
B	9	2	6	9	6	6	yes	6	9	10	10	5	2	10	1,329	104.8
C	1	10	1	1	1	1	no	1	1	1	1	10	3	2	1,054	83.5
D	9	4	9	9	9	9	yes	9	9	10	8	4	8	10	937	76.8
E	5	6	4	2	2	2	no	2	5	5	9	9	10	3	735	62.5
F	6	5	9	5	9	9	yes	9	9	10	8	4	9	10	765	64.6
G	2	9	6	9	6	6	no	5	4	4	3	8	6	10	798	66.9
H	4	8	3	3	3	4	no	4	4	4	3	8	6	10	842	68.4
I	4	8	3	4	6	4	no	4	4	4	4	8	6	10	1,052	83.3
J	9	4	9	9	9	9	yes	9	9	10	8	4	2	10	912	75.1

Note: This table uses number rankings to compare plans A through J. In these rankings, 10 is the best. The numbers are used to show how plans compare to one another. As an example, for Forest, Plan A is ranked 10 (best) and Plans B, D, and J are ranked 9 (next best). This does not mean that Plans B, D, and J have 90 percent of the value for Forest of Plan A; it merely means they are ranked equally just below Plan A. The next highest ranked plan is Plan F, which is ranked 6. This means four plans (A, B, D, and J) are ranked higher. Ranking of impacts of each plan is based on available raw data. In the absence of specific data, the best collective judgment of the Agency Management Group as to relative impacts is presented. Cost data were preliminary.

B.2.81. The 70-percent Lower Atchafalaya River/30-percent Wax Lake Outlet flow distribution at the outlets, with sediment redistribution, would allow for rapid release of floodwaters from the basin, with an opportunity to maximize the natural resource values of the developing delta.

B.2.82. Plan B. This plan would prevent future clearing or timber operations in the floodway, resulting in a loss of income; however, it would provide for public access. While it would preserve existing open water areas, land would become inundated less frequently. This plan is moderately good for water-related environmental values and excellent for land-related environmental values.

B.2.83. Flood protection for the area east of Morgan City would be the same as for Plan A.

B.2.84. Plan C. This plan would significantly increase Mississippi flows below Old River and adversely affect Mississippi River navigation. Decreased water levels in the Red River backwater area and the basin would significantly decrease environmental values but would increase agricultural production potential appreciably.

B.2.85. Lack of any land use controls within the floodway, coupled with the decreased water levels in the basin, would result in substantial land clearing during the life of the project, with the attendent loss of environmental resources, especially fish and crawfish.

B.2.86. The area east of the floodway would continue to receive backwater flood protection to current levels which would result in the opportunity for additional economic development.

B.2.87. Plan D. This plan would provide for the presently authorized distribution of flows between the Mississippi and Atchafalaya Rivers and would not change water levels in the Red River backwater area. As a result of fee acquisition, the basin's environmental values would be preserved; public use of the area would be provided; and commercial crawfishing, fishing, trapping, general recreation, and sport hunting and fishing would be greatly benefited.

B.2.88. This plan is second only to Plan A in preserving the basin's environmental values, and it is also as good as Plan A in providing for public access. It would prevent additional agricultural development within the Atchafalaya Basin Floodway, which would result in loss of income.

B.2.89. The effect on the area east of Morgan City, flow distribution through the outlets, and delta building would be the same as discussed in Plan A.

B.2.90. Plan E. The increased flows down the Mississippi River would adversely affect Mississippi River navigation, but not as much as Plans A or C. The reduced stages in the Red River backwater area would reduce environmental values and increase agricultural production.

B.2.91. Within the floodway, clearing would be prevented, and associated agricultural benefits foregone. Although sediment control features would preserve open water areas, land would be flooded much less frequently. This plan has the lowest water-related environmental values except for Plan C. Land-related environmental values would be good, with only Plan B being better. The lack of public access would limit general recreation and hunting values. The drier overbank conditions would be excellent for commercial timber.

B.2.92. The Avoca Island levee extension feature would give the area east of the floodway continued protection and allow continued growth.

B.2.93. Plan F. This is similar to Plan D, except that an easement in lieu of fee acquisition would be provided and the Avoca Island levee extensions constructed. Public access would be regulated and no area (for example, ridge areas with permanent camps or residences) would be excluded from the easement area. The area east of Morgan City would be provided protection from backwater flooding, allowing continued growth.

B.2.94. Generally, this plan provides for a moderate increase in delta development.

B.2.95. Plan G. The sediment control features would preserve open water areas and, to some extent, the overflow regime in the lower parts of the basin. It does not provide for land use controls; hence, future clearing for agriculture can be expected. This plan ranks high for agriculture and low for land-related environmental values.

B.2.96. The limited structural measures for the area east of the floodway would cause relocations and limit growth.

B.2.97. Plan H. This is the authorized plan. Dredging the 100,000-sf channel would reduce sedimentation in the backswamp areas, but would accelerate draining these areas. Because the plan includes no land use controls, agricultural development in the floodway would continue at the expense of environmental values.

B.2.98. The Avoca Island levee extensions feature would provide continued backwater protection for the area east of the floodway and allow future growth.

B.2.99. Plan I. With this plan, floodway guide levees and floodwalls would continue to be raised. Within the floodway, its impacts are

much the same as those of Plan H. The combined flood-carrying capacity of the outlets would continue to decrease, resulting in increased backwater flooding. Since no protective measures for the area east of the floodway would be provided, flood damages in that area would be severe.

B.2.100. Plan J. This is identical to Plan F, except for the type easement acquired. Government control of timber would provide an opportunity to maintain mature, mast-bearing trees for wildlife as well as trees for cavity-nesting animals.

Features Eliminated from Further Consideration

B.2.101. Utilizing the relative economic and environmental analyses of plan features, the analysis of the plans formulated by the Agency Management Group for the 1979 public meetings, and the results of the meetings themselves, those features to be eliminated from further study could be delineated.

B.2.102. Group I - Alternatives for Operation of the Old River Control Structure. The 1978 analyses indicated that the 35-, 40-, and 45-foot plans would result in greater agricultural development within the Lower Atchafalaya Basin Floodway and the Red River backwater area; however, they would also cause extensive fish and wildlife losses. The clearing that would result from the 35-foot plan with no land use controls could destroy up to 500,000 acres of the 3 million remaining acres of bottomland hardwoods in the southeastern United States. Since little support was received at the January 1979 public meetings for any of these plans and due to agreements among Agency Management Group members, the plans were eliminated from further consideration. It was determined that in some years, flows into the Red River backwater area could be limited during May, June, and July without causing serious damages to environmental interests in the floodway. Conversely, it was also determined that during other years, slightly more water could be passed down the Atchafalaya River without harming agricultural interests. Since short term changes in flow distribution could possibly be accomplished without adversely affecting other resource uses, that variation of this plan was not eliminated from further consideration.

B.2.103. Subsequent to the public meetings, an analysis of the Mississippi-Atchafalaya River system for a 60/40 distribution was performed. The results of this work are discussed in the following paragraphs.

B.2.104. The rating curve for the Mississippi River at Tarbert Landing showed a loss of channel capacity during the period 1950-75. For a discharge of 1,100,000 cfs, the stage in 1950 was 49.5 feet NGVD; in 1973 it was 53.0 feet NGVD; and in 1975 it was 55.0 feet NGVD. During the greater part of this time period, distribution of flows was not controlled daily, and in 1974 the Mississippi River carried as little as 56 percent of the daily latitude flow. In 1976, rehabilitation of the Old River control low sill structure, necessitated by 1973 flood-induced damages, had progressed to the point that effective control of latitude flow to the 70/30 distribution was again possible. Under such control, the rating curve at Tarbert Landing in 1977 and 1978 reflected a steady increase in channel capacity, so that the rising limb of the 1979 rating curve in the early phases of the 1979 rise was nearly the same as the rising limb of the 1950 rating curve, which was about as low as had been observed in the entire period of record.

B.2.105. Subsequent events, however, reflect changes in the capacity of the Mississippi River. In the early part of May 1979, large amounts of deposition were observed at Tarbert Landing. It is reasonable to conclude that significant deposition also occurred throughout the Morganza-Tarbert Landing reach, inasmuch as the stage-discharge relationship at Tarbert Landing tended dramatically to the left, and by the 1979 flood's crest on 23 April, the indicated stage-discharge relationship at Tarbert Landing was about the same as a direct extrapolation of the 1975 relationship. Subsequent measurements as the river fell reflected that the 1979 and 1975 falling limbs were about the same. It is likely that if the 1979 flood had occurred with the 1975 rating curve, peak stages at Old River control would have been substantially higher than those that actually occurred. The actual peak stage in 1979 was about three-quarters of a foot higher than that of 1973, the highest stage experienced since 1927.

B.2.106. The events of the 1979 flood do not, in themselves, constitute an unassailable case for maintaining a 70/30 distribution of latitude flow; but when combined with the behavior of the Tarbert Landing rating curves in 1976, 1977, and 1978, these events do indicate clearly that any change in distribution toward placing a greater flow into the Atchafalaya would be very questionable.

B.2.107. A plan to maintain 60/40 distribution is not a plan for long term management of floods on the lower Mississippi. Instead, it would be a step toward inducing capture of the Mississippi by the Atchafalaya, which, in turn, would result in massive socioeconomic disruptions. If the 60/40 distribution were instituted and instability ensued, the only possibility for avoiding capture would be the return to a 70/30 distribution, keeping more flow in the Mississippi, and even this could not guarantee the desired result.

B.2.108. In summary, maintaining a 70/30 distribution provides a high degree of assurance that the project flood could be safely passed to the gulf. Conversely, a 60/40 distribution provides assurance only if it produces a stable configuration, a condition contrary to what is indicated by data and studies performed to date. The inadequacies of a plan incorporating a 60/40 distribution could not be rectified by constructing a new Old River control structure, however substantial it might be.

B.2.109. Data available to date clearly confirm that little advantage is likely to occur from increasing latitude flows to the Atchafalaya. In fact, this information suggests that the consequences are likely to be adverse or even cataclysmic. Thus, both 60/40 and 65/35 distribution features were eliminated from further consideration.

B.2.110. Group II - Atchafalaya Basin Main Channel Development Alternatives. Engineering and environmental studies performed during evaluation of preliminary plans indicated that dredging a confined 100,000-sf main channel would adversely impact more than 20,000 acres of woodlands and wetlands. Other main channel development alternatives would also result in adverse impacts; therefore, this feature was eliminated from further consideration.

B.2.111. Because an EPA study indicated that an 80,000-sf channel would be the largest to develop naturally, this feature was carefully analyzed. Subsequent studies by the Corps of Engineers have shown that the main channel, over time, would enlarge itself naturally to approximately 100,000 sf. Nevertheless, first costs and average annual equivalents were computed for the 80,000-sf channel. Both far exceeded the cost of other Group II features being investigated. As a result, no further consideration was given to this alternative.

B.2.112. Group III - Alternatives for Sediment Control. Sedimentation in the Lower Atchafalaya Basin Floodway is largely carried into the floodway via distributaries of the Atchafalaya Basin main channel. The sediment transported by a distributary can be divided into two components: bedload and suspended load. The bedload consists of coarse particles or sand; the suspended load generally consists of fine particles of mostly silt and clay. There is no reasonable means to reduce the suspended load short of flocculation, which is extremely expensive and, therefore, infeasible for use on the scale which would be required. Bedload, on the other hand, can be reduced in the distributaries by two techniques: distributary channel realinement and sediment traps. These two features can act either independently or together to provide sediment control. The effectiveness of each feature, whether used separately or in conjunction, is difficult to determine using state of the art literature. Also, direct measurement of bedload in the Atchafalaya River is not practicable. Based on Einstein's approach, as modified by Toffaleti, the bedload in the Atchafalaya Basin main channel is estimated to comprise 15 percent of

the total sediment load. The percent of bedload leaving the main channel is, for all practical purposes, indeterminate. However, bedload sediments usually deposit in three areas: those remaining in the main channel deposit at the lower end of the channel (Atchafalaya Bay); those entering and remaining within a distributary channel deposit at the lower end of the distributary channel; and those leaving either the main or distributary channels as overbank flow deposit adjacent to those channels in the form of alluvial levees. If backswamps are defined as areas not included in the preceding three areas, then only a negligible amount of sediment entering the backswamp is from bedload. By this definition, areas such as Grand Lake, Sixmile Lake, and Lake Chicot are not considered backswamps. Data are not available to determine the percent of deposits in the backswamps; however, it is likely that sands attributed to normal overbank flows constitute a small portion of backswamp deposits.

B.2.113. For the basin as configured in 1975, it is estimated that 20 percent of the sediment is transported into the overbank areas of the Atchafalaya Basin during floodflows (450,000 cfs and above). With time, because of overbank deposition and channel development, sediment in the overbanks made by floodflows will increase to 40 percent. While the percent deposited due to floodflows cannot be determined directly, it may be assumed that the percent deposited during floods is in proportion to the percent being transported.

B.2.114. Sediment traps were eliminated from further consideration due to their requirements for large amounts of land to be used as dredged material disposal areas and the environmental impacts of that disposal. Annual dredging of these traps would require disposal on approximately 3,000 acres of forest and swamplands adjacent to the traps. As a result, little vegetation of commercial value or of value to wildlife would become established at disposal sites.

B.2.115. Group IV - Management Units and Related Features. Subsequent to the 1979 public meetings, management unit area designations were adjusted by Agency Management Group consultations to add Sixmile Lake, Lost Lake, and Cow Island, and to combine Crevasse with Upper Belle River, for a new total of 13 units. Although preliminary studies indicated that some units have a higher potential for restoring historic hydrologic conditions, no units were eliminated from further consideration in preliminary planning stages.

B.2.116. Group V - Alternative Land Use Plans. No land use plans were eliminated in preliminary planning efforts.

B.2.117. Group VI - Alternatives for Floodway Outlets and Delta Building. Engineering evaluation of the floodway outlets and delta building alternatives indicated that construction of levees only, a new floodway outlet near Charenton, a new overbank outlet east of the floodway, or redistribution of major flows to Wax Lake Outlet would

require significantly higher costs than other alternatives. Additionally, land and water requirements for redistribution of major flows to Wax Lake Outlet and a new overbank outlet east of the floodway would be significant. Thus, all of the preceding alternatives were eliminated.

B.2.118. It was determined that if the outlets continue to develop naturally, a 50/50 distribution would result with an overall decrease in the outlets' combined capacity. Since this would violate the planning constraint of safely passing the project flood to the gulf, this alternative was also eliminated.

B.2.119. Group VII - Alternatives to Reduce Backwater Flooding East of the Floodway. None of the plans formulated during early study efforts were eliminated from detailed consideration.

B.2.120. Group VIII - Management Entity. This alternative feature could not be evaluated until the final array of plans was selected.

Features Considered in Detail

B.2.121. A discussion of the features considered in detail is provided in the following paragraphs.

B.2.122. Group I - Alternatives for Operation at the Old River Control Structure. The only measure in this group to be considered in detail is one that will maintain the present 70/30-percent distribution of total flows between the Mississippi and Atchafalaya Rivers below Old River. This alternative includes the possible short term variations in flow previously described.

B.2.123. Group II - Alternatives for Atchafalaya River Main Channel Development and Levee Raising. Levee raising has been an ongoing process since the inception of the Mississippi River and Tributaries project and would be required as part of any plan. However, levee raising without any other measure for passing the project flood through the Lower Atchafalaya Basin Floodway is a viable alternative. It can reasonably be assumed that if no Federal action were taken to address the study planning objectives, the accompanying increasing threat of a severe flood affecting the urban and industrial areas south of Old River would cause local or state governmental entities to continue to raise the levees to preserve the flood-carrying capacity of the floodway. As a result, this feature remained in the planning process and constituted the basic element of the plan that represented future conditions with no further Federal actions (future without-project condition).

B.2.124. Evaluation of the channel training feature indicated that it would provide a net cost savings by reducing the height to which basin protection levees would have to be constructed, while also limiting environmental losses to a greater degree than other alternatives considered. Because of this, channel training was an integral feature of the final array of plans considered.

B.2.125. A similar alternative feature not previously considered was introduced subsequent to the public meetings. This feature provided for dredging portions of the main channel to a much lesser degree than had previously been considered. The modified dredging plan provided for removing about 32,800,000 cubic yards of material from the main channel between mile 101 and mile 114, and because of its potential for decreasing the project flood flowline, this alternative was incorporated in the final array of plans. Subsequent analysis, however, indicated that the differences between channel training and modified dredging were minor and would provide only insignificant differences in the flood flowline and levee height requirements and, therefore, would not effect a cost reduction.

B.2.126. The 100,000-sf dredging plan, presented in the 1963 general design memorandum as the "authorized" plan, provided for dredging from mile 54.5 to mile 111.9 in steps of 60,000 sf, 80,000 sf, and then 100,000 sf. The plan included continuous monitoring to determine if the next step of dredging was required. Of the 443,000,000 cubic yards of dredging expected in 1963, actual dredging of 158,000,000 cubic yards was completed through 1968. Since then, with natural erosive action of the river, enlargement has continued so that now it is estimated that only about 240,000,000 cubic yards would need to be dredged to complete the project as authorized. When compared to only approximately 29,000,000 cubic yards required for channel training, the potential environmental losses were readily apparent. For this reason, completion of the 100,000-sf dredging plan was considered only in the detailed evaluation of the "authorized" plan.

B.2.127. Group III - Alternatives for Sediment Control. As discussed previously, sediment control can be effected by two measures: channel realinement and sediment traps. Because of projected environmental losses and probable ineffectiveness in preventing sedimentation in backswamp areas, sediment traps were eliminated from further consideration. Ongoing model studies at the Waterways Experiment Station (WES) are expected to determine the effectiveness of distributary realinements. The results of these studies will be incorporated into subsequent detailed studies prior to proposed implementation of distributary realinements.

B.2.128. Group IV - Management Units and Related Features. Analysis of the management unit concept indicated that initial implementation of all 13 management units would not be appropriate. Two units, Buffalo Cove and Henderson, should be considered for initial

implementation as pilot projects. Then, based on detailed studies of operation of the two units with representatives of the USFWS, EPA, and appropriate state agencies, recommendations would be made on the engineering and environmental feasibility of developing other management units. Development of other units should be considered.

B.2.129. For the proposed Buffalo Cove pilot unit, a typical design might include control of water into the main portion of the unit by construction of an inlet structure at the junction of the Wanda Canal and the west access channel. Banks around the southwest perimeter of the area would be raised only as necessary to confine average annual peak flows. Two weirs would control outflow from the area. One weir could be located at the main channel leading out of Buffalo Cove Lake and the other about 1 mile south of the Iberia-St. Mary Parish line in Grand Lake. Closures and boat rollover structures would be built at Bayou Eugene where it enters the west access channel and at Si Bon Canal where it enters Lake Fausse Point Cut. An additional boat rollover structure would be built to provide access from Lake Fausse Point Cut into Bayou Gravenburg. To improve water circulation in the unit, openings in canal dredged material banks could be made along the Si Bon Canal, the Wanda Canal, and the Florida Gas Canal.

B.2.130. In the western portion of this unit, inflow of water could be via Little Lake Long with outflow regulated by a weir in the vicinity of Myette Point. Banks along the southeast perimeter of the area would be raised as needed to confine the average annual peak flows.

B.2.131. Inflow of water into the Henderson Lake area could be controlled by the existing Bayou Courtableau structure and the Courtableau water diversion structure, which would be built to divert up to 3,000 cfs from the Atchafalaya River into Bayou Courtableau. Outflow would be via the existing control structure in the borrow pit southwest of Butte LaRose.

B.2.132. Also proposed, as a part of the management unit feature, was construction of the Courtableau and Sherburne freshwater diversion structures. As noted, the Courtableau structure at river mile 48 would serve as an inlet for the Henderson Lake management unit. The Sherburne structure, a gated culvert at river mile 43, would provide freshwater to the Alabama Bayou area by passing up to 3,000 cfs into Big Alabama Bayou. Canal closures and circulation improvements, also part of the management unit concept, would be included in detailed plans.

B.2.133. Closure of certain canals would prohibit sediment-laden waters from entering backswamp areas; selective opening of existing dredged material banks and other features that impede circulation would improve water circulation.

B.2.134. Group V - Alternatives for Floodway Land Use. All real estate interests previously considered were made up of a number of interests which varied from plan to plan. Typical easement and fee title estates included the following:

- Control over conversion of land to other uses
- Prohibit new structures for permanent human habitation
- Prohibit or control other structures, including camps
- Control over excavations and landfills
- Government ownership of timber
- Control over the method of cutting timber
- Permit public access
- Prohibit camps
- The right to flood by any means, for any purpose, and for any length of time
- Occasional flowage rights
- Fee ownership less minerals.

B.2.135. These estates were evaluated separately and in various combinations. The real estate feature was considered additive; i.e., it could be added to any of the final array of plans without affecting the project flood flowline.

B.2.136. During the final phases of this study, the Corps of Engineers solicited real estate recommendations from all Agency Management Group members. Real estate proposals were submitted by USFWS, EPA, and the State of Louisiana for consideration. Because the people residing in the state would be the primary beneficiaries of additional public access in the basin, it was determined that proposals for public access should be in accordance with the State's recommendations.

B.2.137. Group VI - Alternatives for Floodway Outlets and Delta Building. In analyzing the plans for passing the project flood through the outlets to the Gulf of Mexico, it became apparent that these alternatives would have significant effects on the total cost of completing the Atchafalaya Basin Floodway project. Without any control at the outlets, their combined capacity would decrease and the corresponding flow distribution would become approximately 50 percent out Wax Lake Outlet and 50 percent out the Lower Atchafalaya River.

B.2.138. Stabilization of the existing flow distribution, with 30 percent from Wax Lake Outlet, can be achieved by construction of a rock weir at the head of Grand Lake. Calculations indicate that because of high velocities, a gated control structure could be required to control the distribution so that 20 percent of the flow would pass out Wax Lake Outlet. Closure of Wax Lake Outlet to normal flows would also require a rock weir.

B.2.139. Each of these alternative features is incorporated into the final array of plans. While total one-shot restrictions to 20 percent or 0 percent out Wax Lake Outlet would offer the advantages of an anticipated enlargement of the Lower Atchafalaya River cross section, a greater combined outlet capacity, and a future lowering of flowlines in the area, an immediate implementation of such a closure would, in the short term, result in an increase in stages (for low and medium flows) in the vicinity of Morgan City and east of the Avoca Island levee. With the current level of protection and flooding problems in these areas (which occur even for the stages associated with a low-level closure), any increase of stages would be unacceptable. Therefore, maintenance of the 70/30 percent distribution through the Lower Atchafalaya River/Wax Lake Outlet is preferable from an engineering standpoint. However, as noted previously, the rock weir would result in some reduction in low flow and some enlargement of the Lower Atchafalaya River would occur. The effectiveness of the weir could be monitored and if the Lower Atchafalaya River and ecosystem of the area responds favorably, the possibility of further constricting flow through Wax Lake Outlet and eventually constructing a low-level closure could be studied further.

B.2.140. Based on this, some plans in the final array were developed with an initial 70/30 distribution, with possible restrictions to a 80/20 distribution and eventually to a 100/0 distribution. Since it could not be determined if additional restrictions would be desirable in the future, a cost estimate for further restrictions was not developed. Calling the alternative a 70/30 distribution with further restrictions to 80/20 and 100/0 distributions is merely a way of describing these alternative features.

B.2.141. Channel training works below Morgan City would effect a reduction in the project flood flowline and be additive to any of the flow distributions previously discussed. As a result, this measure was included as a separable feature in the final array of plans.

B.2.142. Flowline comparisons made prior to the 1979 public meetings indicated that channel training on both the Lower Atchafalaya River and Wax Lake Outlet was cost effective, resulting in savings varying from \$18 million to \$87 million. Training works would be provided in phased steps, depending upon natural deltaic activity. The cost estimates reflect cost of the training works, which would extend only to the existing mouths of the outlets. Since it is not known to what

extent any future training works might be required, no cost estimates were developed for the future works. The flowlines, however, reflect possible continuance of the channel training program as the mouth of the Atchafalaya River moves gulfward with time because of continued delta development.

B.2.143. The project flowlines for the final array of plans represent conditions 50 years in the future. Such projections must be based on subjective evaluations of future development. All studies of the Atchafalaya River to date have concluded that the bay will continue to develop and, therefore, the mouth of the river will continue to move farther into the bay. As this occurs, it is assumed that what can be done above the mouth to help improve flow in the river now, would also be applicable above the mouth of the river in the future. Current evaluation of channel training works on the outlets indicates that while the training works will reduce overbank deposition, the area would still have a net gain in overbank area. The Atchafalaya Bay modeling effort currently being conducted by WES is expected develop a tool to determine how the proposed channel training works will affect future delta building, salinities, and overbank sediment.

B.2.144. Widening Wax Lake Outlet overbank would allow use of the overbank area during floods exceeding the 10-year frequency. The additional overbank area results in a considerable increase in conveyance capacity of the outlets during a project flood in which the flow distribution would change to about 55/45 percent Lower Atchafalaya River/Wax Lake Outlet. Comparisons of a plan, both with and without the widened overbank, indicate that the project flood elevation can be reduced as much as 3 feet with the widened overbank.

B.2.145. Although no increase in delta would result from implementation of the above features, an increase in that portion of delta served by Wax Lake Outlet could be effected by increasing its share of sediment. This alternative was considered as a separable feature in formulating the final array of plans.

B.2.146. Group VII - Alternatives to Reduce Backwater Flooding East of the Floodway. The existing Avoca Island levee was built to limit project design flood stages east of Morgan City to stages that occurred in that area during the 1945 flood. However, since construction of the levee and the Bayou Boeuf closure would change the Morgan City-Amelia area from an area affected by headwater flow to one affected by backwater flow, the levee could not exactly duplicate conditions of the 1945 flood. The 1945 Atchafalaya River flood stage at Morgan City was 6 feet NGVD and about 4 feet NGVD between Morgan City and Gibson, Louisiana, and also between Morgan City and Pierre Pass, Louisiana. For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City was, in the late 1940's, computed at 4 feet NGVD. To achieve the required project flood stage of 4 feet NGVD east of Morgan City, the new levee south of

Morgan City was alined parallel to the Atchafalaya River, extending about 13 miles south of the city, and terminating at a flowline elevation then estimated at 7.5 feet. The degree of protection provided by the levee varied with the location and elevation within the protected area. For all lands above elevation 4 feet NGVD, complete protection against a project flood was achieved. Lands below 4 feet NGVD, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reductions would diminish with distance eastward from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. To preserve the improvement intended under the original design, extension of the levee by about 2.5 miles is now required to compensate for this rise. As deltaic activity continues, additional extensions would be required to compensate for anticipated future increases in stages. If no extensions are constructed, stages at the end of the existing levee would ultimately rise by more than 6 feet, compared with stage conditions in 1945.

B.2.147. In addition to a proposed earthen levee extension of about 17 miles that follows the navigation channel, a number of alternatives were further investigated subsequent to the 1979 public meetings, including: levee extension with an I-wall; levee extensions utilizing marsh and bayshore alinements; a levee from Morgan City to Houma with pumping facilities for interior drainage; an urban/industrial complex ring levee and navigation structure system; a comprehensive ring levee/pumping system to protect 28 selected residential and industrial developments; collapsible floodwalls around Morgan City and Amelia; and flood-proofing structures and relocating businesses and residences in conjunction with any of the above.

B.2.148. Although first costs were estimated to be close, further analysis of the 28-ring levee plan indicated a substantial annual cost differential above the cost of extending the Avoca Island levee. Additionally, ring levees would provide only localized protection as compared to the regional protection afforded by extending Avoca Island levee. Construction rights-of-way for the rings would necessitate relocation of some 1,900 existing residential, commercial, and public structures. Economically and environmentally, construction of a levee extension topped by an I-wall offered no advantages; moreover, the costs were higher. An analysis of the collapsible floodwall revealed that raising the wall and caulking the panels required 4 to 5 days with 10 days to 2 weeks' notice. The analysis also showed that the collapsible floodwall could not withstand heavy industrial traffic when in the stowed position. Flood-proofing structures in the entire backwater area is considered an impracticable and socially unacceptable solution, as is the relocation of businesses and residences outside the area. Further investigation of the marsh alinement for extending the Avoca Island levee also proved this to be undesirable from an environmental standpoint. Thus, two alternative features were

considered in the final array of plans: extension of the Avoca Island levee, using either the navigation channel alinement or the bayshore alinement, the first two reaches of these alinements follow the same route. Initially, a total extension of about 17 miles was considered. The location of each reach was determined from projections of the delta development in the bay, and an effort was made to keep the end of each levee reach at a point where the river stage would be 7.5 feet for project design conditions. Current estimates indicate that a total of six extensions would be required at approximately 10-year intervals. Exact requirements for future extensions would depend on the rate of development of the bay. Since extending the Avoca Island levee would reduce the amount of overbank area available for conveying a project flood, this could cause higher project flood stages on the Lower Atchafalaya River and thus, at the lower end of the East Atchafalaya Basin Protection Levee and West Atchafalaya Basin Protection Levee. The alinement of the levee immediately adjacent to the channel has the most significant effect by increasing flood heights over those without the extension by up to 2 feet. The bayshore alinement would increase available overbank area and thereby reduce flood heights. However, it should be pointed out that project flood flowlines for a plan that contains the channel alinement Avoca Island levee extension, control of the outlets flow distribution to 70/30, and widening the Wax Lake Outlet overbank is about 1.0 foot lower than the refined 1973 flowline in the Morgan City area and at the lower ends of both the East Atchafalaya Basin Protection Levee and West Atchafalaya Basin Protection Levee.

B.2.149. Because the marsh east of an Avoca Island levee extension depends upon the freshwater and sediment from the Lower Atchafalaya River for nourishment to prevent saltwater intrusion and marsh subsidence, a freshwater diversion structure or structures, was included as part of the extension alternative. The structure was designed to maintain the present distribution of nonfloodflow, currently estimated to be 4,000 cfs, into the west Terrebonne Parish marsh. The structure would divert water into the area until the stage at Amelia, Louisiana, reached 3.0 feet. At this point the structure would be closed for flood protection. The stage duration curves indicated that this stage would occur less than 1 percent of the time with the levee extension. Since freshwater diversion would, on the average, be available 99 percent of the time, no change is expected in the salinity regime due to the project. Sediment concentration of the diverted water would be the same as current diversion concentrations, but it would be more localized. Therefore, increases in marsh loss could be caused by the extension.

B.2.150. Extension of the Avoca Island levee would also require navigation access at the end of each reach or through the levee itself. A navigation structure through the levee would be included in the bayshore alinement. During low to normal floodflows, this would also provide additional diversion of freshwater and sediment to the eastern marshes.

B.2.151. A preliminary environmental analysis indicated that construction of a 14,000-foot extension would not foreclose future options with respect to the Lower Atchafalaya River complex. This analysis, combined with the fact that the levee extension is the only alternative which would protect the entire backwater area, and the largely unknown environmental impacts of the total extension led to the decision to construct only 14,000 feet of the levee extension initially. Protection provided, however, is only a temporary solution. This interim protection would provide an opportunity to complete model tests of the bay complex, review the results, and conduct additional engineering and environmental studies of the backwater area. In order to have a comparable base over the project life, the flowlines used in the economic and environmental analysis of the final array of plans included construction of the entire levee extension.

B.2.152. Group VIII - Management Entity. Since the management entity depends on the features contained in the final detailed plans being considered, a discussion of the management entity proposed for each of the final plans is included in the implementation responsibilities.

B.2.153. Recreation Features. A concept of potential resource use and allocation was developed, which would minimize overall land acquisition and development yet increase public access within the Lower Atchafalaya Basin Floodway. Included in this conceptual plan were areas having the potential to be used for or classified as wildlife refuges, natural areas, public hunting areas, public fishing and crawfishing areas, nature hiking, canoe trail areas, developed and primitive camping areas, boat-launching areas, and areas having significant and unique resources. A detailed discussion of recreation resources is presented in Appendix F.

Formulation of NED, EQ, and TS Plans

B.2.154. In order to prepare the draft feasibility study/EIS, it was necessary to formulate NED, EQ, and Tentatively Selected (TS) Plans for presentation to the public. A total of 10 plans was formulated, utilizing features previously discussed in conjunction with the planning goals and objectives, so that each could be evaluated as a complete unit in terms of its effects on NED, regional development, social well-being, and EQ objectives. These plans are shown in Table B-2-3. The table shows that Plan 1 describes existing conditions. Plan 2 reflects future without-project conditions. Plan 3 represents the 1963 authorized project. The other plans were formulated to represent EQ (Plan 4), NED (Plans 5, 6, and 7), and combinations of EQ

TABLE B-2-3

ALTERNATIVE STRUCTURAL PLANS

Feature	Plan 1	Plan 2	Plan 3	Plan 4	Plan 5	Plan 6	Plan 7 a / b	Plan 8 a / b	Plan 9 a / b	Plan 10 a / b
Old River Control Structure 70%/30% Mississippi/Atchafalaya	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Levee Raising	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Main Channel:										
100,000 Square Feet Dredging (modified)	---	---	---	---	Yes	Yes	---	---	---	---
100,000 Square Feet Dredging	---	---	Yes	---	---	---	---	---	---	---
Channel Training	---	---	---	Yes	---	---	Yes	Yes	Yes	Yes
Sediment Control	---	---	---	Yes	Yes	---	Yes	Yes	Yes	Yes
Management Units	---	---	---	Yes	---	---	No/Yes	No/Yes	No/Yes	No/Yes
Outlets:										
Lower Atchafalaya River/Wax Lake Outlet										
70% / 30%	---	---	---	Yes	---	---	---	---	---	---
100% / 0%	---	---	---	---	Yes	Yes	---	---	---	---
70% / 30% → 80% / 20%	---	---	---	---	---	---	---	---	Yes	Yes
70% / 30% → 80% / 20% → 100% / 0%	---	---	---	---	---	---	Yes	Yes	---	---
80% / 20%	---	---	Yes	---	---	---	---	---	---	---
Increase Sediment to Wax Lake Outlet	---	---	---	Yes	---	---	---	---	---	---
Widen Wax Lake Outlet Overbank	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Channel Training Below Morgan City	---	---	---	---	Yes	Yes	Yes	Yes	Yes	Yes
Backwater Flooding:										
Extend Avoca Island Levee	---	---	Yes	Yes	Yes	Yes	Yes	---	Yes	---
Limited Structural Measures	---	---	---	---	---	---	---	Yes	---	Yes

Note: To develop complete multi-purpose plans, a real estate option and a management entity alternative should be added to each structural plan. All plans include bank stabilization on the Atchafalaya River above mile 55, recreational developments and minor project features.

and NED (Plans 8, 9, and 10). Candidate NED plans were selected on the basis of their capability of generating the lowest possible flowline in the Lower Atchafalaya Basin Floodway, since conversions for agricultural purposes were considered as offering maximum economic return potential.

B.2.155. Features of the EQ plan were chosen to preserve environmental quality in the project area. The sediment control and management unit features would preserve aquatic habitat in the floodway. The extension of the Avoca Island levee was selected for the EQ plan because it was the only alternative considered in detail that reduced flood damages over the entire backwater area. The real estate interests proposed for the EQ plan preserved a large amount of habitat and allowed extensive public access.

B.2.156. Plan 6 was determined to be inferior to Plans 5 and 7 and was eliminated from further consideration as an NED plan because it did not include sediment control features. Sediment control is desired for the NED plan because it would reduce deposition of sediment in backswamp areas and tend to preserve the flood-carrying capacity of the basin. This would result in a lower flowline and a corresponding reduction in the required height and cost of the East and West Atchafalaya Basin Protection Levees.

B.2.157. The selection between the remaining possible NED plans was made on the basis of two features, main channel development alternatives and floodway outlet alternatives. Plan 5 incorporated modified dredging, which would provide essentially the same flowline as the channel training alternative of Plan 7, but would require larger quantities of material to be dredged, generate higher costs, and produce slightly more environmental damage. The elimination of Plan 5 was also supported by the fact that the flow between the Lower Atchafalaya River and Wax Lake Outlet would immediately redistribute from the existing 70 percent via the Lower Atchafalaya River and 30 percent via Wax Lake Outlet to 100 percent and 0 percent, respectively. This shift in flow would result in additional flood damages in the backwater area east of the floodway because of the greater flow down the Lower Atchafalaya River. Flow distribution in Plan 7 would shift gradually from 70/30 to 80/20 and then to 100/0.

B.2.158. The ultimate shift from 70/30 to 100/0 is desirable because it would allow time for the Lower Atchafalaya River to more fully develop, thereby increasing the total outlet capacity of the basin. The more gradual shift from 70/30 to 100/0 with Plan 7 is desirable because by allowing the Lower Atchafalaya River to more fully develop while increasing its flows, there would be little or no additional induced damages in the backwater area northeast of Morgan City resulting from the changes in flow distribution. Thus, Plan 7 was selected as the NED plan.

B.2.159. One of the major considerations in the selection of the TS plan was the Avoca Island levee extension. Plan 9 includes extension of the Avoca Island levee, while both Plans 8 and 10 contain the ring levee limited structural features. Plans 8 and 10 were not chosen because of cost and the social impacts of such features and because they would not fully address the need to reduce backwater flooding throughout the backwater area. The total first cost of the bayshore levee extension would be $338,800,000, while costs of 28 small ring levees would be $377,100,000 and the cost of two large ring levees with navigation structures would be $365,000,000. (Costs shown are October 1980 price levels.) While the total cost of the bayshore levee extension and the 28 small ring levees would be approximately equal, there would be a significant difference in actual annual costs. The annual costs, including operations and maintenance, for the bayshore levee extension and the 28 small rings would be $14,965,000 and $27,204,000, respectively. Since extending the Avoca Island levee would result in higher project flood stages in the lower end of the floodway, a first cost of $30,000,000 was incorporated into the calculation of the bayshore extension annual costs to account for additional construction requirements as well as a first cost of $10,000,000 for a water diversion structure recommended by the FWS. Annual costs for the bayshore extension were substantially lower than the 28 ring levees for two reasons. First, the bayshore extension would involve phased construction, which would occur over a period of about 40 years, thereby reducing the present value of construction costs on which the annual costs are computed. Second, the 28 rings would have an annual operation and maintenance charge of about $3,500,000 compared to a negligible charge for the bayshore extension. If the Avoca Island levee extension were not built, the flowline of the backwater area would continue to rise over the next 50 years. Headwater runoff and tidal influences account for about 50 percent of the existing flooding in the area, with backwater accounting for the remainder. This distribution of floodwater effects will change significantly by the year 2030 as the flooding from backwater influence intensifies. Based on existing development only, the average annual damages for 1980 are estimated to show more than a 20-fold increase by 2030. This dramatic increase would be due entirely to backwater stages rising because of the continuing delta development and its accompanying river elongation. Thus, the need for regional protection of the area from backwater influences will continue to become more acute. While the 28-ring levee plan would provide complete protection from headwater, tidal, and backwater influence with the selected leveed areas, this plan would leave the majority of the area unprotected in the face of ever-worsening backwater conditions, resulting in substantial residual backwater damages in the future. The construction rights-of-way for the ring levees would require the relocation of about 1,900 existing residential, commercial, and public structures. Evacuation and transportation routes would remain subject to flooding. Furthermore, all structures located outside of the ring levees would require

raising, flood-proofing, or removal for prevention of flood damages. Also, without the levee extension, rising waters in the backwater area could damage approximately 7,000 acres of prime and unique farmlands. It is anticipated that numerous archeological sites would also be adversely impacted by flooding. The ring levees would hasten the demise of the Cajun culture by removing the people from immediate access to the bayous. Therefore, Plan 9 was chosen as the TS plan because it was best in satisfying both the national economic development and environmental quality planning objectives.

B.2.160. Detailed studies were made of Plan 4, which emphasizes environmental quality; Plan 7, which emphasizes economic development; and Plan 9, which offered a balanced array of environmental and economic features.

Section 3 - ASSESSMENT, EVALUATION, AND COMPARISON OF NED, EQ, AND TS PLANS

B.3.1. This section assesses and evaluates the three plans prepared for the draft feasibility report/EIS. Costs and benefits presented in this section are those developed prior to publication of the report/EIS. This presentation lists each of the component features, portrays the pertinent aspects of the features which have not been described previously or which elaborate on specificity, evaluates the merits and drawbacks of proposed actions, and delineates the trade-off analyses performed for each of the three plans considered in detail. Plan impacts are discussed in the draft EIS and, therefore, are not included in this appendix. Responsibilities for implementation of the plans, including cost apportionment, are outlined for each plan. Mitigation requirements are also addressed.

Plan 4, Environmental Quality (EQ) Plan

PLAN DESCRIPTION

B.3.2. This plan is comprised of a combination of features that emphasize environmental quality and safely convey the project flood through the Atchafalaya Basin to the gulf. Its features are as follows.

B.3.3. <u>70/30-Percent Distribution of Flows at Old River.</u> This is the present plan of operation for the Old River, Louisiana, project and has been described in detail previously in this appendix.

B.3.4. <u>Modification of Existing Features, Where Required, to Pass the Project Flood.</u> This feature includes raising the East and West Atchafalaya Basin Protection Levees, Atchafalaya River levees, and the levees west of Berwick to grade (Plate B-7), and constructing service roads on levee crowns; modifying Bayou Sorrel, Bayou Boeuf, and Berwick locks; modifying the Charenton, East Calumet, and West Calumet floodgates; modifying the Wax Lake East and Wax Lake West drainage structures; modifying culverts in the East and West Bayou Sale levees; and modifying the Upper Pointe Coupee, Centerville, Ellerslie,

Franklin and Enlargement, Gordy, Maryland, North Bend, Wax Lake East, Wax Lake West, Bayou Yokely and Enlargement, Morgan City, and Tiger Island pumping plants.

B.3.5. Bank Stabilization. Details of this feature are presented in this section under the NED plan.

B.3.6. Training Works on the Atchafalaya Basin Main Channel Above Morgan City. This feature provides for the construction of training works on the Atchafalaya Basin main channel to a height sufficient to confine average annual flows, approximately 450,000 cfs. This requires the dredging of approximately 29,000,000 cubic yards of material from 17.6 miles of channel, from mile 90.0 to mile 116.0, and placing it on the banks within diked disposal areas to simulate the development of natural ridges (Plate B-8). The majority of the works would be below mile 96.0 and would be completely confining; that is, no gaps would be left in the works to allow water to overflow the banks during low flows. Above mile 96.0, work would consist largely of closing gaps between existing disposal areas. Possible bank maintenance work may be required along the main channel in the future from mile 90.0 to mile 53.0 on the east bank and mile 55.0 on the west bank, but it is minor in nature and was not included in cost estimates or impact assessments.

B.3.7. Sediment Control. The sediment control component of this plan includes realining the four principal distributaries of the Atchafalaya Basin main channel to reduce the entrance angle to between 30 and 45 degrees. These distributaries are the Old Atchafalaya River, east freshwater distribution channel, the west access channel, and the east access channel (Plate B-9).

B.3.8. 70/30-Percent Distribution of Outlet Flows. This feature provides for maintaining the present distribution of flows at the outlets by constructing a rock weir at the head of Grand Lake with connecting levees to the West Atchafalaya Basin Protection Levee (Plate B-10). The weir is designed to allow 30 percent of the low to normal flows to reach the Gulf of Mexico through Wax Lake Outlet with the remaining 70 percent being conveyed to the gulf via the Lower Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed to the gulf via the Wax Lake Outlet.

B.3.9. Widening Wax Lake Outlet Overbank. The plan consists of setting back the west Wax Lake Outlet levee an average of approximately 3 miles to the location shown on Plate B-11. The existing west Wax Lake Outlet levee would be degraded to natural ground.

B.3.10. Extension of Avoca Island Levee. This feature consists of a 14,000-foot extension of the Avoca Island levee for the purpose of continuing backwater flooding protection in the area east of the lower

floodway. The length of time for which continuing protection is provided by this alternative is highly dependent upon the actual rate of development of the Atchafalaya delta. Based on current data, it is estimated that measures to provide additional protection from backwater flooding would not be needed until 1993. This extension would include a structure(s) to divert sufficient freshwater to maintain the present distribution of nonfloodflows, estimated to be 4,000 cfs, to the marshes in west Terrebonne Parish. The structure(s) would necessarily be closed when the stage at Amelia, Louisiana, reached 3 feet to provide an acceptable level of damage reduction from Lower Atchafalaya River backwater flooding.

B.3.11. This solution provides an interim period of protection which will allow completion of studies of the Atchafalaya Bay-Terrebonne marsh-backwater complex. Following more detailed studies, to include additional evaluation of the backwater problem and further investigations of the environmental, engineering and socioeconomic feasibility of alternative solutions, a decision would be made on the best means to address flood problems in the backwater area.

B.3.12. The flowline in the basin above Morgan City is affected by all flood control alternatives proposed for implementation in the area below Morgan City. In order to estimate comparable impacts and costs for the evaluation of all flood control features of the detailed plans on a common base, i.e., feature effects on the project flowline for the duration of project life, it was necessary to assume a long term solution to the backwater flooding problem. Since the full extension of Avoca Island levee is the only present long term alternative capable of reducing flood damages over the entire backwater area from both the EQ and NED standpoints, that feature was selected to provide the base for evaluating future project conditions. The EQ plan assumed extension of the levee for 19.6 miles along the bayshore alinement (see Plate B-6), with a navigation structure to provide navigation via the Avoca Island cutoff, to the Lower Atchafalaya River, and on to the gulf.

B.3.13. In summary, a 14,000-foot extension of the Avoca Island levee is proposed for implementation; however, costs and impacts of an entire levee extension were evaluated only as a means of comparing features of the detailed plans over the life of the project.

B.3.14. Recreational Development. This feature consists of three developed and seven primitive campgrounds, one interpretative facility, and 15 launching ramps (providing 51 total or 35 net additional launching lanes), located throughout the Atchafalaya Basin on 1,500 acres of acquired land [(owner retains mineral rights) (Plate B-12)].

B.3.15. Management Units. Thirteen management units (Figure B-3-1) were studied to determine their feasibility for restoring historical water overflow conditions to benefit the aquatic ecosystem. The

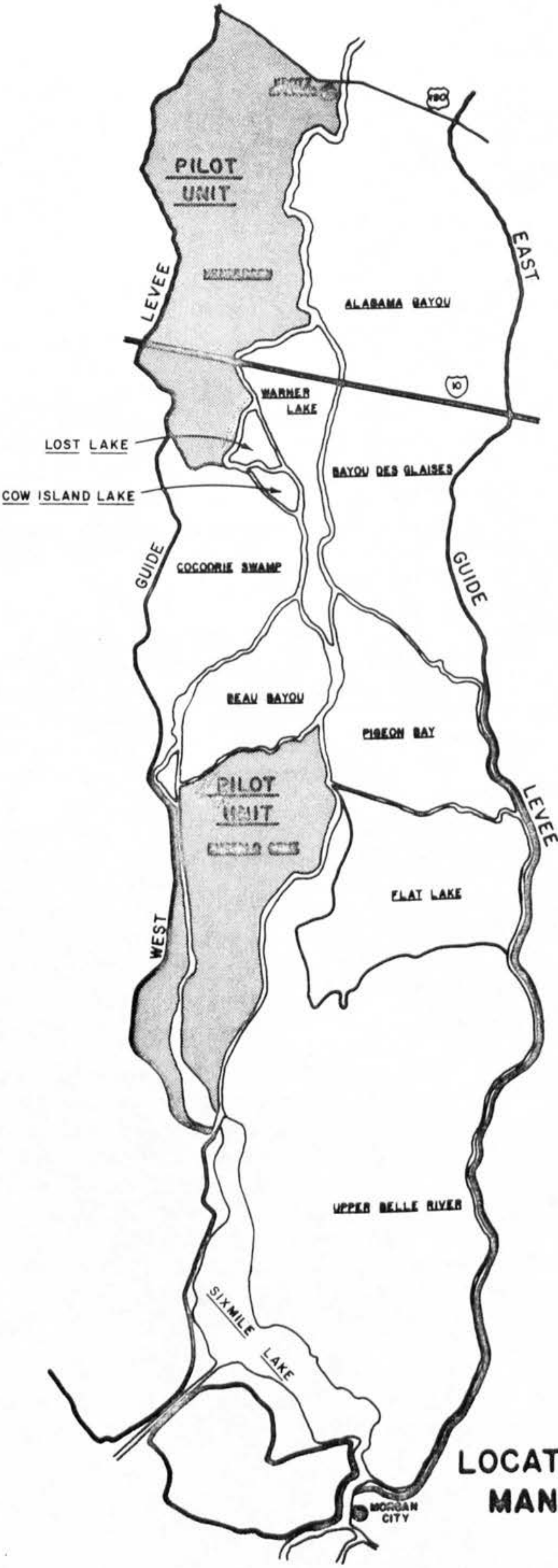

FIGURE B-3-1

LOCATION OF PROPOSED MANAGEMENT UNITS

studies to date indicate that five units--Buffalo Cove, Henderson Lake, Beau Bayou, Flat Lake, and Cocodrie Swamp--have the greatest potential for accomplishing that goal. For this reason, these five were specifically included in the plan evaluation and the costs, benefits, and impacts developed for detailed plan comparison purposes. The Buffalo Cove and Henderson Lake units are proposed as pilot units for initial implementation according to plans developed in conjunction with representatives of USFWS, EPA, and appropriate state agencies. Subsequent to construction, the operation of these units would be closely monitored and an evaluation of their performance made by representatives of the cooperating agencies, using criteria devised by that group, concerning the pilot units' effectiveness in enhancing the aquatic environment. Based on that group's evaluation and recommendations, requests for funding to implement other units would be made. Prior to that time, it is not possible to determine how many additional units are engineeringly and environmentally feasible for implementation. Development of management units would require the restriction of their natural outlets by construction of weirs and in some cases, low-level levees (see Plate B-13). Construction of new inlets at the upper end of the management unit would also be necessary, as well as the closure of certain bayous and canals and the improvement of circulation within the unit. Rollovers to provide for small boat access would be installed at bayou and canal closures.

B.3.16. Freshwater Structures. This feature provides for the construction of the Courtableau and Sherburne freshwater diversion structures to provide freshwater inflow to the Henderson Lake and Alabama Bayou areas, respectively. The Courtableau freshwater diversion structure would serve as an inlet for the Henderson Lake management unit area. It would consist of two 10-foot box culverts with invert elevations of 10 feet NGVD, located in the West Atchafalaya River levee at approximate mile 48.

B.3.17. The Sherburne freshwater diversion structure, which also includes two 10-foot box culverts with invert elevations of 10 feet NGVD, would be located in the east Atchafalaya River levee at mile 43.

B.3.18. Real Estate Interests. The real estate feature of this plan provides for those interests needed to serve three basic functions: flood control, environmental protection, and public access. Real estate interests for both flood control and environmental purposes were developed in specific response to study objectives cited by the authorizing congressional resolutions. The public access function is ancillary to the proposed environmental features of the project, with the citizens of the State of Louisiana being the primary beneficiaries. The state expressed the view that public access in addition to the current state-owned lands (approximately 150,000 acres) was desirable. For this reason, the public access interests proposed were developed in accordance with the recommendations of the Governor, and if authorized by the US Congress, would be acquired in coordination with the state.

B.3.19. The EQ plan provides a real estate feature which addresses both flood control and environmental protection purposes as follows:

- Flood Control. The Flood Control Act of 1936 authorized the US Army Corps of Engineers to acquire certain flowage rights in the Lower Atchafalaya Basin. The Act further specified; "That no flowage easements shall be paid for by the United States over properties subject to frequent overflow in the Atchafalaya Basin below the approximate latitude of Krotz Springs." It was determined that about 68,000 acres in the Lower Atchafalaya Basin Floodway were subject to purchase of flowage easements under this Act. To date, those easements have been obtained on about 9,000 acres. The EQ plan proposes the purchase of flowage rights on the remaining 59,000 acres. In addition, the right to prohibit the construction of new permanently habitable structures and to prohibit or regulate construction of other structures, including camps, would be acquired over all privately-owned land (approximately 445,000 acres) in the lower basin, except for developed ridges. The need for developmental control is associated with operation of the floodway. This right would assure the lower floodway's readiness for operation on short notice, preclude the need for Corps of Engineers emergency flood-fighting operations and associated Federal expenses within the basin, and insure no liability on the part of the Federal Government for the public health, safety and welfare by controlling industrial development that could prove hazardous to the public during floodway operations. These developmental control rights would also serve to preserve the environmental values of the basin, but are considered essential elements of a flood control easement which would provide for the continued unrestricted use of the lower floodway for project flood control purposes.

- Environmental Protection. Real estate interests proposed for protection of environmental values in the lower basin were developed in response to general study goals of the authorizing congressional resolutions and specific study objectives as defined by the Agency Management Group, i.e., to "retain and restore the unique environmental features of the floodways and maintain or enhance the long-range productivity of the wetlands and woodlands." In addition to those rights needed for flood control, the EQ plan proposes rights specifically for environmental protection. These rights are considered necessary for preservation of fish and wildlife habitat and maintaining the "wet and wild" environmental appeal of the lower floodway. Such rights would include control over all excavation and landfill operations and allow for extension of the time and duration of flooding by natural or artificial means. These rights would prevent or delay potential degradation of existing flowage patterns, prevent destruction of habitat and provide for water

level control under the proposed management unit concept. Additional environmental rights would prevent the conversion of land to other uses and provide control over the method of cutting timber. The proposed land conversion control is directed at preventing destruction of fish and wildlife habitat, i.e., clearing of forests for the purpose of agriculture, production of soybeans, or other higher value economic pursuits. Control over timber is also aimed at preserving habitat, as well as maintaining the lower basin's environmental appeal by controlling clearcutting forestry practices. A comprehensive multi-purpose easement, or higher interest if mutually agreed upon, containing the cited environmental interests would be acquired over the entire 445,000 acres of privately-owned land in the lower basin except for developed ridges.

• Public Access. The public access function was subdivided into two basic categories that relate to separate features of the proposed plan. The first, recreation development, was formulated in response to the study authorizing resolutions. The second, general public access, was developed in response to the Agency Management Group defined objective to "maximize public opportunity to observe and utilize the fish and wildlife resources of the floodway" and is based on the recommendations of the Governor of the State of Louisiana.

For the recreational development feature, a total of 1,500 acres would be acquired in fee title throughout the lower floodway to provide for the development of campsites, boat-launching ramps, and other facilities complimentary to destination-type outdoor recreational activities. Included would be a limited number of day-use or picnicking sites and 200 to 500 acres set aside for special and unique areas.

The general public access feature would be accomplished by the acquisition of such additional rights on 103,500 acres of the same 445,000 acres previously cited for environmental protection easements. The public access areas would include 30,000 acres of late successional bottomland hardwood forests, 50,000 acres of cypress-tupelo swamps, 23,000 acres of greenbelts along the edges of selected navigable public waterways and sites along the interior toe of the basin protection levees, and 500 acres of existing rookeries. Additional rights to prohibit harvest of timber would be obtained on 73,500 of the same acres (30,000 acres of bottomland hardwoods, 20,000 acres of cypress-tupelo stands, 23,000 acres of greenbelts and 500 acres of rookeries) over which general public access easements were acquired. These proposed rights are associated with the environmental goal of maintaining or enhancing productivity of the habitat, i.e., allowing the management of timber for fish and wildlife habitat improvement, as well as preserving existing esthetic values to benefit the public access user.

B.3.20. For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

B.3.21. Increase Sediment Through Wax Lake Outlet. This feature proposes dredging a new entrance channel from the Atchafalaya River into Wax Lake Outlet at an angle that would optimize sediment transport (Plate B-14).

B.3.22. Canal Closures and Circulation Improvements. This feature proposes the closing of certain canals that permit sediment-laden waters to enter backswamp areas, as well as improving water circulation patterns throughout the lower floodway by the selective opening of dredged material banks and other features that presently impede circulation.

B.3.23. Management Entity. The District Engineer would be the sole jurisdictional authority to protect and oversee Federal interests in the Atchafalaya Basin Floodway System upon implementation of the proposed comprehensive multipurpose plan. Recreation and environmental features of the plan would be operated and maintained by the appropriate Louisiana State agencies under license and lease agreements administered by the Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on special and collateral interests as required by Federal law and Corps of Engineers' regulations.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.24. Plan 4, the EQ plan, makes an average annual contribution of \$16,564,000 of tangible nonflood control benefits to the NED account when all nonflood control features are evaluated jointly. Average annual tangible nonflood control costs are \$13,521,000 based on 1980 price levels and 7 3/8 percent interest rate. Average annual net benefits, therefore, are \$3,043,000 for an overall benefit-cost ratio of 1.2 to 1. This plan has the lowest benefit-cost ratio of any of the final plans. When the nonflood control features of the EQ plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 9.2 to 1 and the benefit-cost ratio for all other nonflood control features is 0.14 to 1. These other nonflood control features are considered to be justified on the basis of intangible environmental benefits they provide. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, are not subject to incremental evaluation.

B.3.25. The EQ plan makes a highly positive contribution to the EQ account because it protects and enhances areas of natural beauty and enjoyment; preserves and enhances valuable biological, ecological, historical, archeological systems; enhances air and water quality by prevention of pollution; and minimizes irreversible commitment of resources to future uses. This plan preserves the most forest and aquatic areas of any plan. Thus it is the top ranking plan in terms of the EQ account.

B.3.26. The EQ plan makes a positive contribution to the social well-being account by preserving the folk culture of the area. It is the highest ranking plan in this account. It makes no appreciable contribution to regional development and, therefore, ranks lowest in this account.

B.3.27. With regard to project-specific planning objectives, the EQ plan accomplishes or exceeds the following:

- Safely passing the project flood and reducing deposition of sediments in the floodway

- Retaining and restoring the unique environmental features of the floodway and maintaining the long-range productivity of wetlands and woodlands

- Allowing agricultural and mineral development without interfering with the natural environment or flood control to the maximum practicable extent

- Maximizing natural delta formation while providing for navigation is accomplished

- Maximizing public opportunity for observing and utilizing fish and wildlife resources of the floodway is met through optimizing public access to aquatic resources by implementation of the proposed recreation features

- Providing additional access to the lower floodway's terrestrial resources.

B.3.28. The impacts of the EQ plan evaluated under the associated evaluation criteria are likely to be unacceptable to the majority of Atchafalaya Basin landowners, hunting clubs, and the commercial fishing interests in Terrebonne Parish. It is, however, likely to be acceptable to commercial fishermen and trappers, conservation groups, and general environmental interests. The completeness of the plan assumes a pre-authorization and post-authorization moratorium on land clearing activities for success in achieving the environmental preservation goals associated with the proposed real estate interests.

B.3.29. For contributions to national planning objectives/accounts, the EQ plan ranks third for the NED objectives, first for the EQ objectives, first for the social well-being objectives, along with the TS plan, and second for the regional development objectives.

Plan 7, National Economic Development (NED) Plan

PLAN DESCRIPTION

B.3.30. This plan is comprised of a number of features which, when considered as a unit, provide for the lowest flowline practicable. These features are discussed in the following paragraphs.

B.3.31. 70/30-Percent Distribution of Flows at Old River. This feature is similar to that described in the EQ plan but includes provisions for variable operation when conditions warrant maintaining 45 feet at Acme, Louisiana, to assist farmers in the Red River backwater area.

B.3.32. Modification of Existing Features, Where Required, to Pass the Project Flood. This component is similar to that discussed in the EQ plan, except that the NED plan provides the lowest practicable flowline, and thus, a grade reduction for the East Atchafalaya Basin Protection Levee, the Atchafalaya River levees, the West Atchafalaya Basin Protection Levee, and the levees west of Berwick is possible.

B.3.33. Bank Stabilization. Bank stabilization measures, such as articulated concrete mattresses and riprap, along the Atchafalaya River at the locations shown on Plates B-15 through B-19 would be required to protect river levees by controlling the meandering of the main channel.

B.3.34. Training Works on the Atchafalaya Basin Main Channel above Morgan City. This feature is identical to that described in the EQ plan, including future maintenance of existing banks, as needed.

B.3.35. Sediment Control. This feature is identical to that described in the EQ plan.

B.3.36. 100/0-Percent Distribution of Outlet Flows. This feature provides for gradually closing Wax Lake Outlet to low and normal flows by constructing a rock weir at the head of Grand Lake, with connecting levees to the West Atchafalaya Basin Protection Levee. All low and normal flows would be conveyed to the Gulf of Mexico by the Lower

Atchafalaya River. For flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that floodflows could be safely conveyed by Wax Lake Outlet to the gulf.

B.3.37. Widening the Wax Lake Outlet Overbank. This component is identical to that described in the EQ plan.

B.3.38. Training Works below Morgan City. This feature provides for training works below Morgan City on both Wax Lake Outlet and the Lower Atchafalaya River and closure of Bayou Shaffer. Construction of the training works would require dredging approximately 15 miles of the existing channel bottom areas and placing the dredged material in adjacent shallow water bottoms or on adjacent stream banks. Gaps between disposal areas would allow for continued development of the overbank wetlands, navigation access, and pipelines (Plate B-20). The pumped material would be allowed to spread freely to the angle of repose, estimated to be 1 vertical on 40 horizontal. The elevation of the placed material would be limited to a height sufficient to confine average annual flows, an approximate average depth of 3 feet. This would result in an irregular series of low mounds of dredged material, positioned parallel to the channels to simulate naturally formed levees.

B.3.39. Extension of Avoca Island Levee. This feature is identical to that described in the EQ plan.

B.3.40. Real Estate Interests. The real estate feature of the NED plan provides only for those interests needed for flood control and recreation development. These components of the NED plan are the same as described for the EQ plan. For all real estate interests acquired for project purposes, mineral rights would be retained by the landowner. Other real estate interests would be acquired as necessary for implementation of other project features.

B.3.41. Management Entity. The District Engineer would be the sole jurisdictional authority over flood control features of the plan, and recreational features would be operated and maintained by Louisiana State agencies under license agreements administered by the Corps of Engineers. The District Engineer would continue to coordinate with other Federal agencies on collateral interests as required by Federal law and regulations.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.42. Plan 7, the NED plan, makes an average annual contribution of \$14,236,000 of tangible, nonflood control benefits to the NED account. Tangible, nonflood control costs are \$1,717,000 (based on 1980 price levels and 7 3/8 percent interest rate) so that net average

annual benefits are \$12,519,000, yielding a benefit-cost ratio of 8.3 to 1. This plan ranks first in meeting NED planning objectives. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, were not incrementally evaluated.

B.3.43. The NED plan makes a negative contribution to most features of the EQ accounts because it does not prevent clearing in the floodway or have the management unit features to protect the aquatic ecosystem. Of all plans, it is ranked lowest in meeting the EQ objective.

B.3.44. The NED plan, which makes a slightly negative contribution to the social well-being account, is ranked lower than the other two plans. Since a positive contribution is made to the regional development account, this plan ranks first in meeting this objective.

B.3.45. With regard to project specific objectives, the NED plan would:

- Safely pass the project flood, but would do so with consequential environmental damages

- Not retain and restore unique environmental features nor maintain productivity of wetlands and woodlands

- Not allow agricultural and mineral development without interfering with flood control and the natural environment

- Not maximize delta development while providing for navigation

- Not meet the specific goal of maximizing public access to the floodway, but optimize public recreation facilities, thereby providing opportunity for use of aquatic resources in the lower basin.

B.3.46. The response of NED plan to associated evaluation criteria is likely to be unacceptable to environmental and commercial fishing interests, sport fishing clubs, and others who support habitat preservation in the floodway. The plan is complete and effective from the standpoint of project flood control protection.

B.3.47. For contributions to national planning objectives/accounts, this plan ranks first for the NED objectives and highest for the regional development objectives, but ranks lowest of the detailed plans considered for EQ and social well-being objectives.

Plan 9b. Tentatively Selected (TS) Plan

PLAN DESCRIPTION

B.3.48. This plan combines features of the EQ plan with features of the NED plan and results in a compatible mix that addresses both national economic development and environmental quality objectives. The features included in this plan are:

- 70/30-percent distribution of flows at Old River (NED)
- Modification of existing features, where required, to pass the project flood (EQ)
- Bank stabilization (NED)
- Training works on the Atchafalaya Basin main channel above Morgan City (EQ)
- Sediment control (EQ)
- 70/30-to approximately 80/20-percent distribution of outlet flows (TS)
- Widening Wax Lake Outlet overbank (EQ)
- Training works below Morgan City (NED)
- Extension of Avoca Island levee (NED)
- Recreation development (EQ)
- Management units (EQ)
- Freshwater structures (EQ)
- Real estate interests (EQ)
- Canal closures and circulation improvements (EQ)
- Management entity (EQ)

All of these features have been described previously, except the 70/30-to approximately 80/20-percent distribution of outlet flows. The letters in parentheses following the feature indicate the plan under which the description appears, e.g., (EQ) indicates environmental quality plan.

B.3.49. <u>70/30-to Approximately 80/20-Percent Distribution of Outlet Flows.</u> This feature provides for initially maintaining the present distribution of flows at the outlets (70/30), with 30 percent conveyed through Wax Lake Outlet, by constructing a rock weir at the head of Grand Lake, with connecting levees to the West Atchafalaya Basin Protection Levee. As gradual channel development of the Lower Atchafalaya River occurred and if the system responded favorably in terms of the area ecosystem, flow into Wax Lake Outlet would be further restricted by modifying the rock weir to limit low to normal flows entering Wax Lake Outlet to approximately 20 percent. For flows exceeding a 10-year frequency, the low-level levees would be overtopped to allow safe conveyance of floodflows to the gulf.

EVALUATION AND TRADE-OFF ANALYSIS

B.3.50. The TS plan, when all nonflood control features are jointly calculated, makes an average annual contribution of $16,567,000 in tangible nonflood control benefits to the NED account. Tangible nonflood control costs are $12,168,000 (based on 1980 price levels and 7 3/8 percent interest rate) so that net average annual benefits are $4,399,000, and the benefit-cost ratio is 1.4 to 1. Thus, this plan ranks second in meeting NED objectives. When the nonflood control features of the TS plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 9.2 to 1, and the benefit-cost ratio for all other nonflood control features is 0.16 to 1. Despite the excess in costs over tangible NED benefits, the other nonflood control features are considered to be justified and are included in the TS plan because of the intangible environmental benefits they generate.

B.3.51. Because of alternative plan features selected, the TS plan makes a highly positive contribution to all national EQ objectives, a net positive contribution to social well-being, but no net appreciable contribution to regional development objectives.

B.3.52. For the specific planning objectives of safe flood control in an environmentally sound manner, and protection and enhancement of the natural environment, this plan accomplishes these objectives essentially the same as the EQ plan. All other specific planning objectives are met in the same manner as was possible to accomplish by the EQ plan, primarily through the selection of EQ plan features for achieving these goals.

B.3.53. The TS plan's response to associated evaluation criteria will, like the EQ plan, be unacceptable to basin landowners, hunting clubs and commercial fishing interests in Terrebonne Parish, yet be acceptable to fishing clubs, commercial fishermen, and trappers in the floodway.

B.3.54. The geographic scope of this plan is national in nature, and it is reversible to a moderate degree, whereas the NED plan is irreversible like the future without-project condition.

B.3.55. For contributions to national planning objectives/accounts, the TS plan ranks second to the NED plan for achieving national economic development objectives, second to the EQ plan for environmental quality objectives, first for social well-being, and second for regional development objectives. This plan offers the best balance, of all detailed plans considered, toward meeting the national economic objectives and EQ accounts.

Rationale for Designation of EQ Plan

B.3.56. Contributions to environmental quality are favorable changes in the ecological, cultural, and esthetic attributes of natural and cultural resources that sustain and enrich human life (US Water Resources Council, 1980). Most features of the EQ plan would contribute toward environmental quality as defined above, as well as meet the overriding criteria of safely passing the project flood through the Atchafalaya Basin to the Gulf of Mexico. Thus, this plan was designated the EQ plan. The following paragraphs explain how these contributions would occur for each of the EQ plan features yielding a significant environmental quality contribution.

SEDIMENT CONTROL BY DISTRIBUTARY REALINEMENTS

B.3.57. This feature would contribute to preservation of both natural and cultural resources by slowing the rate at which the Lower Atchafalaya Basin Floodway is filling with sediment. This process of sedimentation is destroying wetlands and open water bodies, and this not only reduces aquatic productivity on which many basin-dwellers and recreationists depend, but sedimentation also lowers esthetic values and compounds the loss of cultural resource sites.

MANAGEMENT UNITS

B.3.58. This feature would contribute to preservation of aquatic natural resources by restoring, to the degree practicable, historical water conditions within environmentally and hydrologically distinct areas of the lower floodway. Restoration of water levels in some areas would benefit local residents and recreationists that depend

upon the aquatic productivity of these resources for their livelihood or enjoyment.

FRESHWATER DIVERSION STRUCTURES

B.3.59. These structures would generally provide the same contribution toward environmental quality objectives as would management units, because they would help preserve and improve aquatic natural resources.

CANAL CLOSURES AND CIRCULATION IMPROVEMENTS

B.3.60. These would contribute to improvements in the aquatic environment by helping to prevent introduction of sediment into productive wetland and open water areas and by helping to prevent water quality problems attributed to poor water circulation in swampland areas. These improvements would, in turn, benefit basin-dwellers and recreationists who depend upon aquatic productivity either for livelihood or enjoyment.

REAL ESTATE INTERESTS

B.3.61. Comprehensive multipurpose easements would undoubtedly be the most valuable feature of the EQ plan in terms of contributing to environmental quality objectives. These easements, by preventing clearing of the floodway, controlling the method of cutting timber, and controlling excavation and landfill operations, would preserve much of the ecological productivity of the area on which basin-dwellers and recreationists depend, as well as preserving many of the esthetic attributes that make the basin unique. Likewise, the developmental controls to be obtained for flood control purposes would also serve to protect environmental values of the lower floodway.

RECREATIONAL DEVELOPMENT

B.3.62. These features would contribute to an enrichment of human life by increasing public accessibility to, opportunity for, and enjoyment of the natural and cultural resources of the lower floodway.

DISTRIBUTION OF OUTLET FLOWS: 70/30 LOWER ATCHAFALAYA RIVER/WAX LAKE OUTLET

B.3.63. This feature, to retain present distribution of outlet flows, would contribute to environmental quality by helping maintain the existing ecological trends in the bays south of the project-affected area.

INCREASE SEDIMENT DIVERSION AT WAX LAKE OUTLET

B.3.64. This feature should increase delta development at the mouth of Wax Lake Outlet, which would contribute to environmental quality by increasing the formation of undisturbed marshland in Atchafalaya Bay. Little marshland is presently forming at this location and marshland formation at the mouth of the Lower Atchafalaya River is hampered by the necessity of maintaining a navigation channel through the developing delta.

WIDENING WAX LAKE OUTLET OVERBANK AREA

B.3.65. This feature would greatly improve the ecological conditions of the overbank area by restoring river overflows and tidal influence to its swamps and marshes.

REDUCING BACKWATER FLOODING EAST OF THE FLOODWAY

B.3.66. Extension of the Avoca Island levee is not an EQ feature. It would destroy marsh by direct construction impacts and by increasing the marsh deterioration rate due to reduction of river overflow and it would also contribute to some clearing of forests in the backwater area. On the other hand, it would make a positive contribution to the environment by helping to preserve cypress-tupelo regeneration and farmland in the backwater area. The extension of the Avoca Island levee is the only proposed alternative for solving backwater flooding problems that would be responsive to the legal requirements that an EQ plan be capable of fully achieving project goals throughout the project area. It is for this reason that the levee extension is included in the EQ plan. The plan includes features to fully mitigate environmental losses.

Rationale for Designation of NED Plan

B.3.67. This plan, like the other detailed plans, was developed with the overriding criteria to safely pass the project flood through the Atchafalaya Basin to the Gulf of Mexico. In addition to meeting this criteria, the NED plan specifically attempted to maximize contributions to the NED account for recreation and fish and wildlife resource enhancement, as well as agricultural enhancement. As a result, the plan was comprised of features that would meet these objectives and yet be implementable in terms of the economic, political, social, and environmental systems operating in the area.

B.3.68. Contributions to NED are explained in the following paragraphs for those plan features having a significiant NED contribution.

TRAINING WORKS BELOW MORGAN CITY

B.3.69. This feature would contribute to a lowering of the flowline in the Lower Atchafalaya Basin Floodway, thereby reducing overbank sedimentation and construction costs of other flood control features.

CHANNEL ALINEMENT OF THE AVOCA ISLAND LEVEE

B.3.70. Rationale presented under the EQ plan for the 14,000-foot extension is equally applicable to the NED plan. Additionally, extension of the Avoca Island levee would enhance agricultural development in the backwater area by preventing future rises in backwater flood stages. Selection of the river channel alinement of the Avoca Island levee for this plan was based on its substantially lower construction costs compared to the alternative alinement along the shoreline.

RECREATIONAL DEVELOPMENT

B.3.71. This feature was included because it would generate positive net benefits attributable to the NED account.

100/0-PERCENT DISTRIBUTION OF OUTLET FLOWS

B.3.72. The distribution of outlet flows with no flow through Wax Lake Outlet would increase the total flow capacity of the outlets,

resulting in a lower project flood flowline, and thus, lower construction costs for other flood control features.

REAL ESTATE INTERESTS

B.3.73. Acquisition of easements for purposes other than flood control would not be required, since they would not make positive contributions to the NED account. Acquisition of 1,500 acres of fee land would be required for development of proposed recreation facilities.

Rationale for Tentatively Selected Plan

B.3.74. As with the other plans, this plan meets the overriding criteria of safely conveying the project flood to the gulf. In addition to meeting this criteria, the TS plan offers balance with respect to contributions to both the national economic development and environmental quality accounts. Thus, it would contribute to NED and EQ while being implementable in terms of the economic, political, social, and environmental systems operating in the study area. Table B-3-1 contains a summary of costs, authorization status and purpose of major features of the TS plan.

TABLE B-3-1

COSTS, AUTHORIZATION STATUS, AND PURPOSE OF FEATURES

TENTATIVELY SELECTED PLAN
ATCHAFALAYA BASIN STUDY

Feature	Cost	Requires Congressional Authorization Yes	No	Purpose: Flood Control	Environmental Quality	Public Access	Recreation	Agriculture	Remarks
Old River Control Structure	No additional		X	X					
Short-term variation of flow	No additional		X		X			X	
Modification of features to pass the project flood	$428,462,000		X	X					
Bank stabilization	$78,600,000		X	X					
Main channel development	$44,300,000		X	X					
Sediment control	$38,100,000		X	X					
Management Units	$21,020,000	X			X				
Real estate interests (445,000 acres)									
Flood Control									
Development Control	$12,197,000	X		X					REAL ESTATE: The plan includes comprehensive multi-purpose easements over the entire lower basin that is privately-owned, 445,000 acres excluding developed ridges. In addition, public access rights would be obtained over 103,500 of those same acres, timber rights would be purchased on 73,500 of those same acres and 1,500 acres would be acquired in fee.
Overflow Rights	$5,226,000		X	X					
Environmental	$87,965,000	X			X				
Access	$25,515,000	X				X	X		
Fee	$782,000	X				X	X		
Wax Lake Outlet overbank enlargement (8,000 acres)	$78,600,000		X	X					COST ALLOCATION OF THE REAL ESTATE PLAN: Flood Control $ 17,423,000 Environmental Quality 87,965,000 Public Access 25,515,000 Recreation 782,000 $131,685,000
Outlet works	$9,422,000		X	X					
Avoca Island levee extension (Backwater flooding east of Morgan City)	$50,394,000		X	X					
Recreational development 1/	$17,450,000	X					X		
Freshwater structures	$7,050,000		X		X				
Canal closures and circulation improvements	$1,000,000	X			X				

1/ Includes $782,000 for fee acquisition of 1,500 acres.

Section 4 - DEVELOPMENT OF FINAL EQ, NED, AND RECOMMENDED PLANS

Changes in Final Plans

B.4.1. Subsequent to the public meetings of July 1981 and coordination of the draft feasibility report/EIS with governmental agencies, businesses, organizations, and the general public, changes were made in all plans. These changes concerned three features: the distribution of flows at Old River control structure, portions of the real estate plan, and backwater flooding east of the lower floodway. The following paragraphs present the rationale for altering each feature.

FLOWS AT OLD RIVER CONTROL STRUCTURE

B.4.2. The NED and TS plans presented in the draft feasibility report/EIS included the possibility of slightly varying the 70/30 distribution at Old River control structure. Some years the structure would be operated to maintain a stage of 45 feet at Acme, Louisiana, during May, June, and July to benefit agricultural interests in the Red River backwater area. During drier years, flows down the Atchafalaya River would be increased to benefit fishery resources in the floodway. Since the public meetings were held, further studies on the possibility of varying flows have shown that operational changes are unacceptable on both engineering and environmental grounds.

B.4.3. Studies to date, including those supporting the authorization of the Old River control structure, and analyses of the behavior of the Atchafalaya and Mississippi Rivers over the period of 1973 to date, have shown that it is necessary to maintain not less than 70 percent of the total annual volume of latitude flow in the channel of the Mississippi River south of the Old River in order to insure that capture of the Mississippi River by the Atchafalaya River does not occur. Day to day departures from the 70/30-percent distribution are possible; but since it is impossible to predict the subsequent hydrograph of latitude flow, the ability to redress the volumetric imbalances created by the departures is limited. In other words, it would be feasible some years to reduce flows through the Old River control structure in order to maintain a stage of 45 feet at Acme for the benefit of agricultural interests as called for in this alternative, but it would probably not be feasible to increase flows

significantly into the Atchafalaya River other years to benefit fishery interests. To increase flow into the Atchafalaya would promote the instability of the Mississippi-Atchafalaya system and enhance the possibility that the Atchafalaya River would eventually capture the Mississippi. If it were not feasible to increase flows into the Atchafalaya River some years to mitigate the low flows of previous years when water was held at 45 feet at Acme, then significant environmental losses would occur in both the Lower Atchafalaya Floodway and in the Red River backwater area. Additionally, other environmental losses would occur even if it were possible to increase flows during drier years. Some of these losses (based upon a worst-case analysis) from both sources are summarized in the following paragraphs.

B.4.4. Induced clearing of about 1,000 acres of bottomland hardwood forest in the Red River backwater area probably would result; and under Plan 7 (NED) conditions, additional clearing of an undetermined amount of forestland in the Lower Atchafalaya Basin Floodway would be induced. Economic losses from the eliminated forest products and from trapping and recreational use of these forest areas would also be anticipated.

B.4.5. Pollution of aquatic habitats in the Red River backwater area and Lower Atchafalaya Basin Floodway would increase due to increased agricultural activity.

B.4.6. A reduction of one-half or more in water exchange within existing aquatic habitat in the Red River backwater area would occur. This action would degrade the aquatic habitat and reduce the standing crop and productivity of fish and other aquatic organisms; thereby, causing a corresponding reduction in economic benefits generated from commercial and recreational fishing.

B.4.7. Overbank flooding would be eliminated during May, June, and July on about 77,000 acres of forest and swampland within the Lower Atchafalaya Basin Floodway by 2030. This reduced flooding would degrade the aquatic habitat and would lead to losses in economic benefits from commercial and recreational fishing. An estimate of the magnitude of these losses to commercial and sport fishing under 2030 conditions in a year when the 45-foot plan would be put into effect is given below:

Species	Annual Pounds Lost
Buffalo	145,000
Catfish	280,000
Crawfish	2,100,000
Sunfish	38,000
Largemouth bass	64,000

These losses to commercial fisheries would result in a loss of net income to fishermen of about $810,000 under these conditions.

B.4.8. Freshwater input into the Atchafalaya delta-Terrebonne marsh complex would be reduced. Since this freshwater input brings with it nutrients and organic matter important in the maintenance of a productive commercial fishery for species such as shrimp, oyster, and menhaden, a corresponding reduction in economic benefits, which would be generated from fishing for these species, would no doubt occur.

B.4.9. An analysis of the economic benefits that would be generated in the form of increased agricultural production and associated damages prevented in the Red River backwater area due to the 45 feet at Acme plan revealed benefits of about $1.4 million annually. This analysis and a partial analysis of environmental impacts in the Red River backwater area was proposed and submitted by the Vicksburg District, US Army Corps of Engineers. (See attachment 1 at the end of this appendix.) Additional material concerning economic and environmental impacts in the lower floodway is on file at the New Orleans District. About half of these benefits would, however, be generated within areas for which previously authorized ring levee systems are being planned--systems which would not cause environmental losses in the lower floodway. Although the measurable economic losses to resources, such as commercial fisheries, in the lower floodway from the 45-foot plan would not equal the benefits to agricultural and related activities, it seems apparent that the total economic losses to all commercial fisheries, both freshwater and marine; the timber industry; and recreational activities would be quite large. Moreover, mitigation measures needed to replace fishery losses generated by the 45-foot plan would be substantial. Because of these facts and because of the constraints which exist with regard to variable operation of the Old River control structure, the feature recommended for all plans is to continue the existing 70/30 operational scheme.

PORTIONS OF THE REAL ESTATE PLAN

B.4.10. The public access interests proposed in the Tentatively Selected Plan of the draft report/EIS were developed in accordance with the 1980 recommendations of the Governor of the State of Louisiana (see attachment 2). During the public meetings of July 1981, general opposition to the "greenbelt" portion of the plan was expressed by landowners and hunters, while environmental interests generally favored "greenbelts." Many landowners voiced opposition to the public access easements and originated an alternate proposition whereby the state would be offered certain lands for acquisition on a "willing seller" basis. These lands, plus those which were included in a donation to the state by the Dow Chemical Company, were proposed as a substitute for the public access easements cited in the draft report. The comprehensive multipurpose easements proposed for flood control and environmental protection over the entire Lower Atchafalaya Basin Floodway were generally supported by both landowners and

environmental groups and remained as part of the landowners' alternative proposal.

B.4.11. Subsequent to the July meetings, a compromise proposal for public access was developed through the cooperative efforts of major opposing interests. Prominent national and local environmental organizations worked with representatives of the landowners and the state toward this end. A key element of the new proposal which makes it acceptable to the environmental community is a recommended tightening of provisions of the comprehensive multipurpose easement to prohibit land use conversion. A key issue resolved by the new proposal is the elimination of the "greenbelts" included under the prior public access proposal. The details of the compromise plan for public access were announced by Governor David C. Treen during a press conference on 19 November 1981, as a substitute for the public access provisions he had recommended in November 1980 and which were presented in the draft report. (See attachment 3 for a summary of the press conference and attachment 4 for the environmental community's proposal for the comprehensive multipurpose easement.

B.4.12. Thus, the Recommended Plan in the final feasibility report/EIS includes this real estate compromise because it is favored by environmental groups, landowners, and the State of Louisiana. The compromise public access plan was not included as part of the EQ plan in the final report/EIS as the 1980 State of Louisiana real estate plan would provide greater protection to the cypress-tupelo swamps by virtue of the purchase of governmental timber rights on 20,000 acres of cypress-tupelo swamp. The compromise plan would allow 217,000 fewer annual user days of recreation by 2030. This lost recreation would be mainly that associated with the "greenbelts." Also, by retaining the 1980 state proposal in the EQ plan, it is possible to compare the impacts of that plan and the compromise plan. Additionally, the comprehensive multipurpose easement was included in the final EQ, as well as the Recommended Plan.

BACKWATER FLOODING EAST OF THE LOWER FLOODWAY

B.4.13. At the time of public release of the draft report, the proposed extension of the Avoca Island levee had been determined to be the only viable alternative for maintaining an equivalent amount of flooding over the entire area of backwater influence east of the Lower Atchafalaya Basin Flooday to generally the level of flooding experienced in that area during the 1945 flood, the protection criterion that the existing levee was provided to meet. The amount of flooding from backwater is dependent on the volume of floodflows conveyed through the floodway system as influenced by the flood control features and the natural alluvial riverine process at work in the basin. The level of flooding from backwater is directly related to

the water level or stage in the Lower Atchafalaya river at the end of the Avoca Island levee. The further development of the delta in Atchafalaya Bay will result in elongation of the course of the river and, thereby, raise the stage at the end of the existing levee for a given discharge. Thus, if the existing levee is not extended, flooding resulting from backwater influences on the area east of the floodway will become more frequent and more severe (greater depths) as the delta develops over time. For this reason, a 14,000-foot extension of the Avoca Island levee was proposed as a feature of the Tentatively Selected Plan in the draft report of 22 June 1981 as an interim measure. This extension was to continue current protection levels for the backwater area.

B.4.14. Because of the dynamic state of development of the delta and the environmental vulnerability of the marsh in the vicinity of the Avoca Island levee, substantial public opposition to extending the levee was expressed during the recent public review of the draft report. Review comments underscored both the environmental values of the Terrebonne marsh to the east of the proposed levee extension and uncertainty concerning potential impacts of the proposed work.

B.4.15. Since the public meetings, the multiple effects of all other proposed flood control features of the plan but excluding the extension of Avoca Island levee have been investigated. The plan feature for widening the Wax Lake Outlet overbank would redistribute flow through the outlets for floods with a probability of occurring less frequently than once in 10 years, and thereby provide for reductions of stages in the Atchafalaya River. Such reductions for the more severe floods serve to reduce backwater flooding in the area east of the floodway.

B.4.16. As described in the draft report, the Avoca Island levee extension is a time-phased construction with the need for adding subsequent extensions directly related to future rises in the project flood flowline. This, in turn, is dependent on conveyance capacity in the Lower Atchafalaya River and accompanying delta development in Atchafalaya Bay.

B.4.17. During the study period to date, a large base of hydraulic and hydrologic engineering data have been generated relative to the analysis and selection of alternatives for improving the conveyance capacity and efficiency of the floodway proper without undue environmental degradation. However, this data base was developed within acceptable confidence limits at the expense of precisely defining all associated hydraulic, hydrologic, and biological parameters in the Atchafalaya Basin outside of the floodway.

B.4.18. Present engineering studies are not of sufficient scope to accurately determine the length of levee extension required to protect the area east of the floodway with the proposed flood control features in place. Ongoing model studies of delta growth will provide a more

reliable basis for making this determination. In addition, further studies are needed for determining changes in subsidence, flow patterns, salinity regimes, and sediment transport within the Terrebonne marshes for the proper assessment of biological and environmental impacts. These studies can be accomplished concurrently with the ongoing model studies.

B.4.19. In summary, further extension of the Avoca Island levee is the only alternative which would provide protection over the entire area of backwater influence east of the floodway; therefore, it remains as a feature of the NED plan. However, more precise engineering and biological parameters must be determined to provide a better understanding of the impacts the recommended flood control features would have on the complex, dynamic, and delicate ecosystem of the bay-marsh complex before implementation of further extensions of the levee and/or other structural or nonstructural features associated with backwater protection can be proposed. The needed studies would be completed by 1985 and a supplemental EIS will be prepared for the specific feature decided upon at that time. Thus, the EQ and the Recommended Plans recommend delaying implementation of any action associated with backwater flooding east of the lower floodway; whereas, the NED plan recommends implementation of the first reach of the Avoca Island levee extension.

FEATURES OF FINAL PLANS

B.4.20. Table B-4-1 summarizes the changes in plans between the draft and final report/EIS. Table B-4-2 delineates the features of the final EQ, NED, and Recommended Plans.

Assessment and Evaluation - EQ Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.21. The EQ plan makes an average annual contribution of \$18,983,000 of tangible nonflood control benefits to the NED account when all nonflood control features are evaluated jointly. Average annual tangible nonflood control costs are \$18,538,000 based on 1981 price levels and 7 5/8 percent interest rate. Average annual net benefits, therefore, are \$445,000 for an overall benefit-cost ratio of 1.02 to 1. When the nonflood control features of the EQ plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 8.5 to 1 and the benefit-cost ratio for all other nonflood control features is 0.10 to 1. These other nonflood control

TABLE B-4-1

COMPARISON OF PLANS IN DRAFT AND FINAL REPORT/EIS

Feature	Draft Report/EIS EQ Plan	Final Report/EIS EQ Plan	Draft Report/EIS NED Plan	Final Report/EIS NED Plan	Draft Report/EIS TS Plan	**Final Report/EIS Recommended Plan**
Flows at Old River Control Structure	Continued 70/30 annual distribution.	Continued 70/30 annual distribution.	70/30 with flows varied, Atchafalaya River flows slightly increased some years and decreased others.	Continued 70/30 annual distribution.	70/30 with flows varied, Atchafalaya River flows slightly increased some years and decreased others.	**Continued 70/30 annual distribution.**
Prevention of Backwater Flooding	First reach of Avoca Island levee extension.	Delay of implementation until completion of additional studies.	First reach of Avoca Island levee extension.	First reach of Avoca Island levee extension.	First reach of Avoca Island levee extension.	**Delay of implementation until completion of additional studies.**
Real Estate	1980 State of Louisiana public access and environmental easement proposal.	1980 State of Louisiana public access proposal. 1981 compromise environmental easements.	No public access. Flood control easements only.	No public access. Flood control easements only.	Same as draft EQ.	**1981 State of Louisiana public access and environmental easement proposal.**

TABLE B-4-2

FEATURE SUMMARY FOR FINAL PLANS

Feature	EQ	NED	Recommended
Flow Distribution at Old River	Existing operational scheme. 70% Mississippi River; 30% Atchafalaya (on annual basis)	Same as EQ.	Same as EQ.
Modifications to Existing Features to Pass Project Flood	As required levee raising, lock mods, pumping plants, etc.	Same as EQ.	Same as EQ.
Training Works on Main Channel Above Morgan City	Confine flows of 450,000 cfs, mile 90.0 to 116.0.	Same as EQ.	Same as EQ.
Sediment Control	Principal distributary realinements.	Same as EQ.	Same as EQ.
Distribution of Outlet Flows	70% LAR/30% WLO (normal flows)	100% LAR/0% WLO (normal flows)	70/30 to 80/20 (gradual shift)
	Floodflows overtop control	Floodflows overtop control	Floodflows overtop control
Widening Wax Lake Outlet Overbank	Widen overbank about 3 miles.	Same as EQ.	Same as EQ.
Recreation Development	Camping, boat ramps, and support facilities	Same as EQ.	Same as EQ.
Management Units	Freshwater structures - water level control, circulation improvements.	Not included.	Same as EQ.
Real Estate Interests Flood Control	Flowage and developmental control.	Same as EQ.	Same as EQ.
Environmental Protection	Prohibit land conversion, control timber, flowage, excavation, and fill.	Not included.	Same as EQ.
Public Access	General access, "greenbelts," and timber.	Not included.	Dow donation and willing seller.
Recreation	1,500 acres fee title.	Same as EQ.	Same as EQ.
Increase Sediment through Wax Lake Outlet.	New channel - delta building.	Not included.	Not included.
Canal Closures and Circulation Improvements	Close selected channels and open selected channel blockages.	Not included.	Same as EQ.
Management Entity	NOD District Engineer and state agencies.	Same as EQ.	Same as EQ.
Bank Stabilization	ACM/Riprap	Same as EQ.	Same as EQ.
Training Works Below Morgan City	Not included.	15 miles low mounds.	Same as NED.
Backwater Flooding East of Morgan City	Completion of additional studies prior to implementing levee extensions or other alternative measures.	14,000-foot interim extension of Avoca Island levee and freshwater diversion structure.	Same as EQ.

features are considered to be justified on the basis of intangible environmental benefits they provide. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, are not subject to incremental evaluation.

B.4.22. The statements presented in Section 3 under EQ plan EVALUATION AND TRADE-OFF ANALYSIS are applicable. The social well-being account would be diminished slightly due to delaying implementation of a backwater flooding feature. The objective of safely passing the project flood will be accomplished upon resolution of backwater flooding problems.

MITIGATION REQUIREMENTS

B.4.23. Mitigation requirements of the EQ Plan would arise due to an estimated loss of 200 annualized habitat units (AHU's) of marsh habitat. Since implementation of this plan would result in a net gain of over 400,000 AHU's of bottomland hardwood-open land habitat and almost 3,000 AHU's of swamp habitat, it was assumed that these gains would offset the small loss of marsh habitat. Methods used in calculating mitigation needs are explained in Appendix G.

B.4.24. Cultural Resources. Responsibility to accomplish mitigation of losses of cultural resources is limited to National Register and Register-eligible properties subject to irreparable loss or destruction as the result of activities involving terrain alteration. Mitigation requirements relative to cultural resources cannot be determined at this stage of planning. The only existing project feature that has been subjected to an intensive cultural resources survey is the ongoing enlargement of the Atchafalaya Basin protection levees.

B.4.25. This survey located one archeological site in the probable impact zone, which has been determined to be eligible for inclusion in the National Register. The survey report is in draft form and the effects of the levee raisings upon significant cultural resources is currently being determined. Cultural resource mitigation requirements cannot be fully assessed until the intensive cultural resource surveys of all the selected plan's features are completed. Mitigation requirements will be determined for cultural resources which are determined eligible for inclusion in the National Register that would be adversely affected by the project.

IMPLEMENTATION RESPONSIBILITY

B.4.26. Cost allocation and cost apportionment by project purpose for the EQ Plan are shown in Table B-4-3. As shown in the table, costs are apportioned using the cost-sharing policy proposed by President Carter in his June 1978 water policy message to the Congress and traditional cost-sharing policies. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $111,490,000 toward total construction costs. All estimated operation and maintenance costs, except those attributed to mitigation, would be borne by non-Federal interests.

B.4.27. Under traditional cost-sharing policy, all flood control costs are borne by the Federal Government (Section 2 and portions of Sections 3 and 4 of Public Law No. 391, 70th Congress). A non-Federal cash contribution of $2,201,000 toward construction costs of other features would be required in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation and enhancement of fish and wildlife would be borne by non-Federal interests.

B.4.28. For purposes of determining Federal-state cost-sharing responsibilities, the Atchafalaya Basin is not a traditional water resources development project. Thus, the project should be considered exempt from the traditional policies, the President's cost-sharing policy, and provisions of PL 89-72, 89th Congress, S. 1229, 9 July 1965 under Section 6(e), which states in part that "cost-sharing and reimbursement provisions of the Act shall not apply to non-reservoir local flood control projects," beach erosion control projects, small boat harbor projects, hurricane protection projects, or "to project areas or facilities authorized by law for inclusion within a national recreation area or appropriate for administration by a Federal agency" as part of a national forest system, as part of the public lands classified for retention in Federal ownership, or "in connection with an authorized Federal program for the conservation and development of fish and wildlife." The preauthorization study was authorized by both the House of Representatives and the Senate of the United States, as cited under Study Authority, i.e., "...developing a comprehensive plan for the management and preservation of the water and related land resources of the Atchafalaya River Basin, Louisiana, which would include...improvements of the area for commercial and sport fishing..."

B.4.29. The Atchafalaya Basin Floodway is a nonreservoir flood control project, but goes far beyond the scope of a local project. The project areas or facilities may become authorized by law to satisfy the intent of the study authority resolution, which directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport

TABLE B-4-3

COST ALLOCATION AND COST APPORTIONMENT FOR ENVIRONMENTAL QUALITY PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1]		ANNUAL O&M		FIRST COST[1]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$596,528,000	$198,843,000	--	$14,439,000	$795,371,000	--	$14,439,000	
Recreation	15,271,000	18,665,000	--	383,000[2]	16,968,000	$16,968,000	--	$383,000[2]
Enhancement of Commercial Fish	7,222,000	380,000	--	--	7,602,000	--	--	--
Enhancement of Fish and Wildlife	80,520,000	98,412,000	--	50,000	134,199,000	44,733,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$699,541,000	$316,300,000	0	$14,872,000	$954,140,000	$61,701,000	$14,439,000	$433,000

[1] Interest during construction is not included in costs.

[2] Based on estimate included in Appendix F.

fishing, as well as commercial fishing potential. The project or facilities are considered appropriate for administration by a Federal or state agency. In view of current administrative policy of placing more responsibility for operation and maintenance of water resource projects in the hands of local authorities, it is proposed that the State of Louisiana take responsibility for operation and maintenance of management units, recreational developments, and lands acquired for public access as included in this plan. Flood control features, dredge and fill (Section 404 and Section 10), and real estate management permits programs will remain under the control of the Corps of Engineers through license and lease agreements with the state.

B.4.30. Lands of the Atchafalaya Basin are not part of a national forest system. However, further justification for exemption of the Atchafalaya Basin Floodway from cost-sharing requirements may be based on the basin's national environmental prominence as one of the largest forested wetlands (river swamp) existing in the United States today that remains in a semi-natural state. The charge for preservation of this vast and irreplaceable resource, while maximizing public opportunity to observe and use its fish and wildlife resources, is clearly beyond the scope of traditional Corps of Engineers water resource development projects. The Governor of the State of Louisiana, in the state's Land-Use Proposal, transmitted by letter 5 November 1980 to the District Engineer, recommended that "...management of non-flood control elements of the final Atchafalaya Basin plan should be through State of Louisiana agencies" (see Attachment 2). This appears to more than satisfy previous legislative and executive intent for assuring local cooperation and participation in Federal flood control projects.

B.4.31. Under a cost-sharing arrangement, described in the preceding paragraphs, the Federal Government would bear a first cost of $999,903,000; and non-Federal interests, a first cost of $15,938,000. Annual operation and maintenance activities costs of $414,439,000 associated with flood control would be borne by the Federal Government. A $33,000 cost for operation and maintenance for recreation and environmental protection and enhancement would be borne by non-Federal interests.

Assessment and Evaluation - NED Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.32. The NED plan makes an average annual contribution of $16,551,000 of tangible, nonflood control benefits to the NED account. Tangible, nonflood control costs are $2,055,000 (based on 1981 price levels and 7 5/8 percent interest rate) so that net average

annual benefits are $14,496,000, yielding a benefit-cost ratio of 8.1 to 1. This plan ranks first in meeting NED planning objectives. The flood control aspects of each plan considered in detail are a part of the overall Mississippi River and Tributaries project and thus, were not incrementally evaluated.

B.4.33. The statements presented in Section 3 under NED plan EVALUATION AND TRADE-OFF ANALYSIS are applicable.

MITIGATION REQUIREMENTS

B.4.34. Fish and Wildlife Habitat. Mitigation needs for the NED plan to replace loss of fish and wildlife habitat would arise due to the estimated loss of about 6,400 annualized habitat units of bottomland hardwood and open land habitat, about 8,500 annualized habitat units of flooded forest, and about 3,000 annualized habitat units of marshland habitat. (If the entire Avoca Island levee extension were built, it would be necessary to replace 19,200 annualized habitat units of marsh, and about 11,000 annualized habitat units of swamp habitat.) Methods used in calculating mitigation needs are explained in Appendix G. The best method to mitigate for the loss of flooded forest habitat and about a third of the swamp habitat would be to build the Buffalo Cove management unit. (This assumes that building the unit would actually benefit aquatic resources.) This action would maintain the present water levels and thus prevent clearing. At the present time, 23,910 acres of early successional bottomland hardwoods and 11,730 acres of cypress-tupelo are flooded yearly in Buffalo Cove. In the future with the NED plan, only 5,100 acres of early successional and 6,120 acres of cypress-tupelo forest would be flooded. Therefore, construction of the management unit would preserve flooding on 18,797 acres of early successional forest with an HQI of 0.27 for a total of 5,075 AHU's preserved. Flooding would also be retained on 5,610 acres of cypress-tupelo forest with an HQI of 0.55 for flooded forest for a total of 3,085 AHU's of flooded forest preserved. This flooding would also preserve about 4,000 AHU's of swamp habitat if one assumes a preservation credit of 1.0 for swampland saved by building the management unit. Thus, construction of the management unit would preserve a total of about 8,200 AHU's of flooded forest habitat and 4,000 AHU's of swamp habitat which would mostly mitigate for the overall 8,500 AHU's loss of flooded forest habitat. To mitigate for the remaining 7,100 AHU's of swamp habitat it might be possible to build a water diversion structure which would direct sufficient Mississippi River water into existing swampland south of the river downstream from Donaldsonville, Louisiana, so that the habitat quality index of the swamps would be raised in a manner similar to that described for the future without-project mitigation plan (see Appendix G). A structure similar to the one described below for marsh habitat mitigation would probably suffice. To mitigate for loss of 6,400 AHU's of bottomland forest-open land habitat it would be

necessary to purchase and manage, as described for the future without-project condition, 16,800 acres of bottomland hardwood habitat. To mitigate for loss of 2,900 AHU's of marshland, it is proposed that management of marsh through freshwater introduction be carried out by diverting water from the Mississippi River into suitable areas adjacent to the river. Costs for these mitigation measures are shown in Table B-4-4.

* B.4.35. Cultural Resources. Losses of cultural resources associated with the NED Plan would be mitigated in the same manner described in the EQ plan.

IMPLEMENTATION RESPONSIBILITY

B.4.36. Cost allocation and cost apportionment by project purpose for the NED plan are shown in Table B-4-5. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, relocations, and a cash contribution of $98,747,000 toward total construction costs. All estimated operation and maintenance costs, except those attributed to mitigation, would be borne by non-Federal interests.

B.4.37. A non-Federal cash contribution of $8,991,000 (based on construction of the first reach of the Avoca Island levee) toward construction costs of other features would be required, in addition to a portion of lands, easements, rights-of-way, and relocations. The operation and maintenance costs attributed to recreation and enhancement of fish and wildlife would be borne by non-Federal interests.

B.4.38. The study authority directs management and preservation of the basin's natural resources, including improvements for public recreational purposes, i.e., sport fishing, as well as commercial fishing potential. Actual basin resource users and those who benefit from such activities transcend state boundaries. As is the case of traditional cost-sharing for flood control, recreation costs should also be borne by the Federal Government. Thus, the Federal Government would be responsible for total first costs of $936,006,000; and non-Federal, $1,875,000. Operation and maintenance costs for flood control, $14,673,000, would be borne by the Federal Government while non-Federal interests would bear annual costs of $383,000 for recreation.

* Revised 5/13/82

TABLE B-4-4

ESTIMATED MITIGATION COSTS FOR NED PLAN

Action	Total First Costs $	Annual I&A[1] $	Annual O&M[2] $	Total Annual Costs $
Purchase of 16,800 acres of Bottomland Hardwood Forest	13,144,000[3]	1,003,000	25,000[4]	1,028,000
Freshwater Diversion (Swamp)	15,000,000	1,145,000	--	1,145,000
Freshwater Diversion (Marsh)	15,000,000[5] (100,000,000)[6]	1,145,000[5] (7,630,000)[6]	-- --	1,145,000[5] (7,630,000)[6]
Implement Buffalo Cove Management Unit	3,700,000[7]	282,000	10,000	292,000
TOTAL	(46,844,000)[5] (131,844,000)[6]	(3,575,000)[5] (10,060,000)[6]	(35,000) (35,000)	3,610,000[5] (10,095,000)[6]

1/ Interest and Amortization - 7 5/8 percent for 100 years.
2/ Operation and Maintenance.
3/ Based on a unit land cost of $580 per acre, contingency cost of 25 percent, acquisition costs of $4,000 per tract for 110 tracts, development costs of $50 per acre, and total resettlement costs of $20,000.
4/ Assumed to be $1.50 per acre.
5/ Cost for first levee extension only.
6/ Cost for entire levee extension.
7/ Derived from data used in cost estimate preparation for the EQ plan.

TABLE B-4-5

COST ALLOCATION AND COST APPORTIONMENT FOR NATIONAL ECONOMIC DEVELOPMENT PLAN

	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1]		ANNUAL O&M		FIRST COST[1]		ANNUAL O&M	
Purpose	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$653,011,000	$217,670,000	--	$14,638,000	$870,681,000	--	$14,638,000	--
Recreation	9,160,000	11,196,000	--	383,000[2]	10,178,000	10,178,000	--	383,000[2]
Enhancement of Commercial Fish	--	--	--	--	--	--	--	--
Enhancement of Fish and Wildlife	--	--	--	--	--	--	--	--
Mitigation	35,133,000	11,711,000	26,000	9,000	46,844,000		35,000	--
TOTALS	$697,304,000	$240,577,000	26,000	$15,030,000	$927,703,000	$10,178,000	$14,673,000	$383,000

[1] Interest during construction is not included in costs; costs based on implementation of 14,000-foot extension of Avoca Island levee.

[2] Based on estimate included in Appendix F.

Assessment and Evaluation - Recommended Plan

EVALUATION AND TRADE-OFF ANALYSIS

B.4.39. The Recommended Plan, when all nonflood control features are jointly calculated, makes an average annual contribution of $18,659,000 in tangible nonflood control benefits to the NED account. Tangible nonflood control costs are $18,508,000 (based on 1981 price levels and 7 5/8 percent interest rate) so that net average annual benefits are $151,000 and the benefit-cost ratio is 1.01 to 1. Thus, this plan ranks third in meeting NED objectives. When the nonflood control features of the Recommended Plan are broken down into recreation development features and all other nonflood control features, the benefit-cost ratio for recreation development is 8.2 to 1, and the benefit-cost ratio for all other nonflood control features is 0.13 to 1. Despite the excess in costs over tangible NED benefits, the other nonflood control features are considered to be justified and are included in the Recommended Plan because of the intangible environmental benefits they generate.

MITIGATION REQUIREMENTS

B.4.40. Mitigation requirements are the same as for the final EQ plan.

B.4.41. Cultural Resources. Losses of cultural resources associated with the Recommended Plan would be mitigated in the same manner described in the NED plan.

IMPLEMENTATION RESPONSIBILITY

B.4.42. Cost allocation and cost apportionment by project purpose for the Recommended Plan are shown in Table B-4-6. Under the President's cost-sharing policy, the non-Federal portion includes the costs of all lands, easements, rights-of-way, and relocations, and a cash contribution of $100,999,000 toward total construction costs. All estimated operation and maintenance costs would be borne by non-Federal interests.

B.4.43. Under the traditional cost-sharing policy, all flood control costs are borne by the Federal Government. No non-Federal cash contribution toward construction costs of other features would be required, but the acquisition of a portion of lands, easements,

TABLE B-4-6

COST ALLOCATION AND COST APPORTIONMENT FOR THE RECOMMENDED PLAN

Purpose	President's Cost-Sharing Policy				Traditional Cost-Sharing Policy			
	FIRST COST[1]		ANNUAL O&M		FIRST COST[1]		ANNUAL O&M	
	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal	Federal	Non-Federal
Flood Control	$575,920,000	$191,973,000	--	$15,606,000	$767,893,000	--	$15,606,000	--
Recreation	17,824,000	21,786,000	--	383,000[2]	19,805,000	19,805,000	--	383,000[2]
Enhancement of Commercial Fish	7,222,000	380,000	--		7,602,000	--	--	--
Enhancement of Fish and Wildlife	77,805,000	95,096,000	--	50,000	129,676,000	43,225,000	--	50,000
Mitigation	--	--	--	--	--	--	--	--
TOTALS	$678,771,000	$309,235,000	0	$16,039,000	$924,976,000	$63,030,000	$15,606,000	$433,000

1/ Interest during construction is not included in costs.

2/ Based on estimate included in Appendix F.

rights-of-way, and relocations would be. Operation and maintenance costs attributed to recreation and enhancement of environmental resources would be borne by non-Federal interests.

B.4.44. The rationale presented for the implementation responsibility for the EQ plan is equally applicable to this plan, based on the selection of alternative features common to both plans. Because this project goes far beyond the scope of a local project in all aspects, particularly its national environmental prominence as one of the largest forested wetlands (river swamp) existing in the United States in a semi-natural state, and the congressional mandate to develop "...a comprehensive plan for the management and preservation of water and related land resources of the Atchafalaya Basin, Louisiana...," the total first cost of $936,797,000 for the project should be borne by the Federal Government with non-Federal interests bearing a cost of $51,209,000. Table B-4-7 shows cost allocation of the nonstructural real estate feature of the Recommended Plan versus what was proposed in the Tentatively Selected Plan. it should be noted that total non-Federal costs incresed from 9 percent to 27 percent, and even though the Recommended Plan total cost increased by over $19 million, the total Federal cost decreased by over $32 million. The annual Federal cost for operations and maintenance of flood control features would be $15,606,000, while non-Federal interests would be responsible for operations and maintenance of recreation facilities and management for environmental resources for fish and wildlife enhancement at an estimated annual cost of $433,000.

TABLE B-4-7

COST ALLOCATION OF NONSTRUCTURAL REAL ESTATE FEATURE
(1 October 1981 Price Levels)

	Tentatively Selected Plan			Recommended Plan		
	Total	Federal	Non-Federal	Total	Federal	Non-Federal
Flood Control	$ 21,510,000	$ 19,635,000	$ 1,875,000 1/	$19,732,000	$17,857,000	$ 1,875,000 1/
Environmental	114,866,000	100,803,000	14,063,000 1/	100,538,000	86,475,000	14,063,000 1/
Public Access	31,422,000	31,422,000	--	66,693,000	31,422,000	35,271,000 2/
Recreation	874,000	874,000	--	874,000	874,000	--
Total	$168,672,000	$152,734,000	$15,938,000	$187,837,000	$136,628,000	$51,209,000
Percent of Total	100	91	9	100	73	27

1/ Credit for cost over 150,000 acres of state land.

2/ Credit for Dow Chemical Company donation to State of 30,000 acres. = $19,153,000

Cost of "willing seller" fee purchase land of 48,000 acres ($47,540,000) in excess of TS plan public access cost ($31,422,000) = $16,118,000

$35,271,000

Section 5 - COMPARISON OF FINAL PLANS

B.5.1. Comparative information on the final detailed plans and future without-project condition are presented in this section.

Comparison of Detailed Plans

B.5.2. A comparison of the final detailed plans with the future without-project condition is included in the Summary Comparison of Alternative Plans (Table B-5-1). This table provides a summary of significant beneficial and adverse impacts of the alternative plans that were used for the purpose of trade-off analyses and decision making. The table also describes major features of each alternative plan, displays plan response to planning objectives, and presents performance of each plan against specified evaluation criteria.

B.5.3. Structural plans. All of the detailed plans are structural plans. Even the no-action or future without-project plan assumes the continuation of structural works in the form of the Atchafalaya Basin protection levees. This is necessary because of the significance of the floodway in safely passing the project flood via the Mississippi River and its floodway systems.

B.5.4. The detailed plans do not contribute to water conservation for the purpose of beneficial reductions in water uses or water losses. The plans considered in detail do not provide practicable opportunities for water conservation in this sense.

B.5.5. Flood control features were considered to fall under the overall Mississippi River and Tributaries project benefit-cost ratio and consequently were not incrementally evaluated. The nonflood control aspects, when jointly evaluated, were economically justified for all plans. Of the total nonflood control benefits a minimum of 89 percent would accrue to the proposed construction of recreation facilities. The other environmental features, while providing only limited economic benefits, were considered justified on the basis of their intangible benefits and contributions to the study goal of environmental protection.

B.5.6. Overall Versus Incremental Evaluation of Nonflood Control Features. The importance of the recreation development feature to the overall evaluation of nonflood control features is presented in Table B-5-2. The annual benefits generated by the proposed recreation development plan represent approximately 89 percent of the total annual nonflood control benefits of the EQ and Recommended Plans, and

TABLE B-5-1

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
I. PLAN DESCRIPTION					
A. Old River Control (Mississippi River/Atchafalaya River)		70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.	70%/30% flow distribution on daily basis.
B. Levees		Levee raising (assumed by local interests).	Levee raising.	Levee raising.	Levee raising.
C. Main Channel		---	Channel training.	Channel training.	Channel training.
D. Sediment Control		---	Distributary realinement.	Distributary realinement.	Distributary realinement.
E. Management Units (MU's)		---	Buffalo Cove and Henderson Pilot Units initially; others possible in future.	No MU's.	Buffalo Cove and Henderson Pilot Units initially; others possible in future.
F. Outlets (Lower Atchafalaya River/Wax Lake)		---	70%/30%; increased sediment, Wax Lake Outlet; widen overbank, Wax Lake Outlet.	70%/30% > 80%/20% > 100%/0%; widen overbank, Wax Lake Outlet; channel training below Morgan City.	70%/30% with possible future control 80%/20%; widen overbank, Wax Lake Outlet; channel training below Morgan City.
G. Backwater Area Northeast of Morgan City		---	Implementation dependent on completing additional studies.	Avoca Island Levee (14,000-foot extension)	Implementation dependent on completing additional studies.
H. Public Recreation		---	Facilities development; increased access as proposed in 1980 State of Louisiana plan.	Facilities development.	Facilities development; increased access as proposed in 1981 substitute plan.
I. Real Estate Interests		Flowage easements only as required by 1936 Flood Control Act.	Flood control easements; environmental easements; recreational fee acquisition (1,500 acres); public acccess easements landowners retain minerals.	Flood control easements; recreational fee acquisition (1,500 acres); landowners retain minerals.	Flood control easements; environmental easements; recreational fee acquisition (1,500 acres); public access on state land; landowners retain minerals.
II. SIGNIFICANT IMPACTS (NET)[1/]					
A. Economic					
1. Agriculture		$5,946,000 average annual net income.	$3,342,000 average annual net income.	$6,805,000 average annual net income.	$3,342,000, average annual net income.
2. Displacement of Farms		Impacts similar to the Recommended Plan.	Impacts similar to the Recommended Plan.	No displacement of agricultural land would occur.	Approximately 7,000 acres of agricultural land in the backwater area northeast of Morgan City would be lost due to rising water levels.
3. Fisheries		$5,820,000 average annual net income.	$6,400,000 average annual net income.	$5,460,000 average annual net income.	$6,400,000 average annual net income.
4. Oil, Gas, and Minerals	Extensive oil, gas, and mineral activities in project-affected area.	No impacts, but oil and gas extraction would become much less important as reserves are depleted.	Impacts similar to the Recommended Plan.	The Avoca Island levee and channel training above and below Morgan City could have adverse impacts on access for exploration and production of oil and gas. Restrictions on structure construction could also cause minor inconveniences.	MU's and nondevelopment easements could cause minor inconveniences with respect to exploration and production of oil and gas.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
5. Prime and Unique Farmlands	Prime is existing farmland in Henderson area. Prime and unique is sugarcane land of backwater and Teche Ridge. Potential unique includes all cypress-tupelo and uncleared ridge areas in backwater.	Rising waters could render 7,000 acres in backwater unavailable for agriculture. Agriculture in Lower Atchafalaya Basin Floodway would increase pollution on thousands of potential unique acres (crawfish ponds).	Impacts similar to the Recommended Plan.	Would preserve 7,000 acres in backwater but clearing in Lower Atchafaaya Basin Floodway would increase pesticide pollution on thousands of acres of potential unique farmland (crawfish ponds).	Rising waters could render 7,000 acres in backwater unavailable for agriculture, but would keep pesticides out of thousands of acres of potential unique farmland (crawfish ponds) in Lower Atchafalaya Basin Floodway.
6. Recreation	269,000 annual user-days of supply valued at $7,469,000.	251,000 average annual equivalent user-days of supply valued at $6,892,000.	1,537,000 average annual equivalent user-days of supply valued at $25,230,000. Real estate features preserve forest and provide access which enhances recreation. Fee acquisition of 1,500 acres provides a large amount of this recreation.	1,320,900 average annual equivalent user-days of supply valued at $23,354,000. Clearing for agriculture and construction impacts, and loss of delta caused by Avoca Island levee would reduce recreation when compared to the EQ or recommended plans. Major source of recreation in this plan is fee acquisition of 1,500 acres.	1,321,000 average annual equivalent user-days of supply valued at $24,944,000. Real Estate features enhance recreation potential and preserve habitats. Intensive development on 1,500 acres fee acquisition provides substantial recreation benefits.
7. Timber	Commercial forests comprise 40 percent of study area. $5,960,000 average annual net income.	Resource would decrease significantly as land clearing continues and harvest of existing cypress forest progresses. $5,410,000 average annual net income.	Resource would decrease slightly from present due to construction impacts. However, resource would be significantly greater than under FWO. $5,474,000 average annual net income.	By 2030, approximately one-fourth of the timber resources in the area would be lost due to clearing. $5,300,000 average annual net income.	Resource would decrease slightly from present due to construction impacts but would be greater than FWO condition. Average annual net income of $5,446,000.
8. Navigable Waterways	Many navigable waterways present, with good access to most areas.	Present conditions would be maintained.	Adverse impacts due to MU's, channel training in the Atchafalaya River, and restriction of Wax Lake Outlet.	Adverse impacts would occur due to channel training in Atchafalaya River and Lower Atchafalaya River, extension of Avoca Island levee and closure of Wax Lake Outlet.	Adverse impacts would occur due to MU's, channel training in the Atchafalaya River and Lower Atchafalaya River, and restriction of Wax Lake Outlet.
9. Wildlife	$185,000 annual net income.	$179,000 average annual net income.	$184,000 average annual net income.	$177,000 average annual net income.	$184,000 average annual net income.
10. Employment		Minor employment opportunities would be provided by levee raising, and conversion of forest to cropland and the development of water-based industry in the vicinity of Krotz Springs. Destruction of fisheries habitat would reduce employment opportunities. Rising stages in backwater area would reduce employment opportunities in business and industry.	Impacts similar to the Recommended Plan.	Essentially the same as FWO except employment opportunities in business and industry would not be lost due to rising stages in the backwater area and water-based industry would not be allowed to develop due to restrictions on the construction of structures.	Minor employment opportunities would be provided by construction of plan features. Employment decline in fishing would be greatly reduced as fisheries habitat is preserved. Rising stages in backwater area would reduce employment opportunities in business and industry. This threat would, however, be moderated compared to FWO as a result of the widening of Wax Lake Outlet. Employment from water-based industry would not occur due to nondevelopmental restrictions in the floodway.
11. Regional Growth	The industrial complex located in and around Morgan City holds the greatest potential for spurring regional growth.	Rising stages in the backwater area would pose a significant hindrance to the growth potential of the Morgan City industrial complex.	Impacts similar to FWO, but with a lesser threat due to the mitigating effect of widening Wax Lake Outlet.	By extending the Avoca Island levee the impediment to industrial expansion and regional growth would be lessened.	Rising stages in the backwater area would pose a significant threat to the growth potential of the Morgan City industrial complex, but is mitigated somewhat by the effects of widening Wax Lake Outlet.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
12. Local Government Finance		The conversion of forestland to cropland could cause the converted acres to be assessed and taxed at a higher rate, increasing the tax base and contributing favorably to tax income. This could also occur with the development of water-based industry in the vicinity of Krotz Springs. However, rising water levels in the backwater area could force the relocation of industrial facilities, thereby reducing the tax base and tax revenue.	Impacts similar to the Recommended Plan.	Same as FWO but to a larger degree with respect to forestland conversion, but not at all with respect to the development of water-based industry due to restrictions on structure construction. Rising water level in the backwater area would be prevented thereby helping to preserve the industrial tax base and tax revenue. There also would be some small increase in sales tax revenue from increased expenditures of recreationists.	Easements associated with this plan would prevent agricultural expansion and the development of water-based industry in the floodway, thereby, preventing the generation of additional tax revenues. Impacts of tax revenues related to the industrial base in the backwater area would be similar to FWO, but less severe. There would also be some small increase in sales tax revenues from increased expenditures of recreationists.
B. Social					
1. Displacement of People		Displacement would occur as a result of levee raising. Rising water levels in backwater area could cause displacement of residents.	Impacts similar to the Recommended Plan.	Impacts similar to the EQ plan, but with no displacement in the backwater area.	Displacement would occur as a result of levee raising and the widening of Wax Lake Outlet. Rising water levels in the backwater area could also cause displacements, but this threat would be less than FWO due to the mitigating effect of widening Wax Lake.
2. Community Cohesion	Unique cultural heritage and lifestyles of the Atchafalaya Basin dependent on swamp resource utilization have created strong community cohesion.	The Lower Atchafalaya Basin Floodway would become drier and with the conversion of forest to cropland, it would become increasingly more difficult to preserve traditional lifestyles and communities.	Impacts similar to the Recommaneded Plan.	Impacts essentially the same as FWO, except for a beneficial impact from the Avoca Island levee extension which would prevent water levels from rising in the backwater area, and an adverse impact resulting from increased public access.	Preservation of swamp habitat would help to maintain traditional lifestyles. However, there might be adverse impacts resulting from increased public access, and from rising water levels in the backwater area.
3. Community Growth		The most significant influence on community growth would be the negative effects resulting from rising backwater area stages.	Impacts similar to the Recommended Plan.	This plan removes the hindrance to growth in the backwater area, but would restrict structural development in the floodway.	Reduces hindrance to growth in the backwater area to some degree through the mitigating effects of widening Wax Lake outlet on rising water levels. Floodway growth is restricted through nondevelopmental easements.
4. Health, Safety, and Security of Life	Health, safety, and security of life are currently threatened by the inability of the floodway system to safely pass the design flood.	Levee raising would provide the capability of safely passing the design flood. However, rising water levels in the backwater area would produce adverse impacts to the residents of that area.	Impacts similar to the Recommended Plan.	This plan safely passes the design flood and prevents rising backwater area stages by extending the Avoca Island levee, thereby generating positive impacts.	This plan safely passes the design flood; however, water levels in the backwater area would increase, but to a lesser degree than FWO.
5. Public Facilities and Services		No impacts.	Impacts similar to the Recommended Plan.	Impacts similar to the Recommended Plan.	Increased visitations in the lower floodway resulting from the recreation development plan might necessitate a greater level of public services, e.g., sanitation and law enforcement.
6. Emergency Preparedness	Floodway inadequate to pass major flood. Minor delays in its use could be engendered by existing development in floodway.	Floodway would be able to pass major flood but delays in its use could be engendered by expanded development in the floodway.	Same as the Recommended Plan.	Same as FWO but with fewer potential delays in operation due to restrictions on structure development.	Floodway would be able to pass major flood and restrictions of development would insure that few delays in putting it into operation would occur.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
7. Noise	Area is relatively noise-free compared to other areas. Most existing noise due to boat traffic.	Noise levels temporarily rise during levee raising. Noise levels would increase as agricultural and oil and gas development multiplied. Noise associated with recreation and commercial fishing would decrease.	In southern portion of area, plan would preserve aquatic habitat and boating would increase noise levels over FWO. In northern portion, environmental easement would keep area quieter than under FWO.	Permanent noise would be greatest with this plan due to agricultural development and recreational usage.	In southern portion of area, plan would preserve aquatic habitat and boating would increase noise levels over FWO. In northern portion, environmental easement would keep area quieter than under FWO.
8. Property Ownership	In the Lower Atchafalay Basin Floodway approximately 60 percent of privately-owned land is vested in 13 major property owners. The remaining 175,000 acres are controlled by some 3,200 owners.	Impacts would occur to the extent of land requirements for levee raising.	Impacts similar to the Recommended Plan.	Impacts due to land requirements for construction would be greater than the EQ plan but much less for real estate features, since this plan includes only fee acquisitions and nondevelopment and flowage easements.	In addition to land requirements for plan construction, there would be impacts due to nondevelopment easements, flowage easements, environmental easements, and fee acquisitions in the lower floodway, except for fee purchases from willing sellers for public access and timber ownership easements.
C. Cultural					
1. Culture of the Basin	A unique folk culture, based upon utilization of swamp resources, developed in the basin in the mid-1800's. Although the heart of the swamps has largely been abandoned and the inhabitants have moved to the edges of the floodway, folk traditions, lifestyles and skills remain.	The continuing sedimentation and drainage of the swamps would adversely impact the extractive economy base, and thus, the life-style of those who live on the edges of the floodway. This would have far-reaching effects upon folk culture.	This plan would slow the deterioration of the natural conditions upon which the folk culture of the basin is based. However, increased recreational use of the basin would conflict with established commercial use patterns.	This plan would be most detrimental as it would accelerate deterioration of swamp production and thus undercut the economic base of the basin's folk culture. Increased recreational use would cause competition between recreationists and commercial fishermen over the dwindling resource base.	This plan would slow the deterioration of the natural conditions upon which the folk culture of the basin is based. However, increased recreational use of the basin would conflict with established commercial use patterns.
2. Archeological Resources	Over 252 prehistoric and historic archeological sites are recorded. However, these sites represent an incomplete sample of the resources expected to exist.	Archeological resources would be adversely affected as the burial of sites by sedimentation, unregulated development in the basin, the widening and deepening of the Atchafalaya River, and ongoing levee enlargement would continue.	By regulating land development and maintaining natural conditions through MU's, this plan would lessen the processes that adversely impact archeological resources. However, construction related to project features would affect archeological sites and increased public access would increase vandalism and pothunting.	This plan would be the most detrimental to the resource base as it would accelerate the processes which adversely impact archeological resources. Construction related to project features and increased public access would adversely affect archeological resources.	By regulating land development and maintaining natural conditions through MU's, this plan would lessen the processes that adversely impact archeological resources. However, construction related to project features would affect archeological sites and increased public access would increase vandalism and pothunting.
3. National Register Properties	Two cultural resources have been determined eligible for the National Register of Historic Places. Ten additional significant cultural resources possibly eligible for inclusion in the National Register also exist.	The ongoing levee enlargement would possibly impact one of the two National Register-eligible properties and six of the additional 10 cultural resources identified as possibly eligible for the National Register.	Same as FWO except that other project features would possibly impact additional cultural resources identified by future investigations as eligible for the National Register.	Impacts similar to the EQ plan.	The ongoing levee enlargement would possibly impact one of the two National Register-eligible properties and six of the additional 10 cultural resources identified as possibly eligible for the National Register. Other project features would possibly impact additional cultural resources identified by future investigations as eligible for the National Register.
D. Environmental					
1. Physical Land Features and Geology	Alteration of physical land features by sedimentation deposits.	Up to 9 feet of sedimentation will be deposited in areas of the Lower Atchafalaya Basin Floodway.	Sedimentation control measures will minimize impacts to the extent practicable.	Same as the EQ plan.	Sedimentation control measures will minimize impacts to the extent practicable.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
2. Biological Resources					
a. Audubon Society Blue List Species	Range of 50 species includes project area.	Species living in forests or marshes would decline in numbers as the habitat declines.	Plan would benefit forest species.	Plan would be greatly detrimental to most species--especially those inhabiting forests and brackish and saline marshes. Increased pollution caused by agriculture would also have adverse impacts.	Plan would benefit forest species.
b. Early Successional Bottomland Hardwoods	93,900 acres	35,700 acres in 2030. Bulk of 58,200-acre loss due to clearing for agriculture.	58,500 acres in 2030. 35,400-acre loss from base mostly due to plant succession. 22,800-acre gain over FWO.	42,100 acres in 2030. 51,800-acre loss from base mostly due to land clearing. 6,400-acre gain over FWO.	60,400 acres in 2030. 33,500-acre loss from base mostly due to plant succession. 24,700-acre gain over FWO.
c. Mid-to-Late Successional Bottomland Hardwoods	332,000 acres	186,000 acres 146,000-acre loss mostly due to land clearing for agriculture.	339,000 acres in 2030 153,000-acre gain over FWO due to environmental easements.	178,000 acres in 2030 154,000-acre loss from base mostly due to land clearing. 8,000-acre loss from FWO due to land clearing.	339,000 acres in 2030 153,000-acre gain over FWO due to environmental easements.
d. Cypress-Tupelo Swamps	451,000 acres	415,000 acres in 2030. 36,000-acre loss mostly due to land clearing.	408,800 acres in 2030 Impacts similar to the Recommended Plan.	364,000 acres in 2030 87,000-acre loss from base due to land clearing and plant succession. 51,000-acre loss from FWO mostly due to land clearing and plant succession.	408,000 acres in 2030 42,800-acre loss from base mostly due to plant succession. 7,000-acre loss from FWO mostly due to plant succession.
e. Fresh Marshes	321,000 acres	243,000 acres in 2030 78,000-acre loss due mostly to existing marsh deterioration trends.	243,000 acres in 2030 79,000-acre loss from base. 300-acre loss from FWO mostly due to direct construction impacts.	239,000 acres in 2030 83,000-acre loss from base. 5,000-acre loss from FWO, mostly due to accelerated marsh loss caused by Avoca Island levee.	242,000 acres in 2030 79,000-acre loss from base. 1,000-acre loss from FWO, mostly due to direct construction impacts of channel training below Morgan City.
f. Brackish Marshes	89,000 acres	64,000 acres in 2030 25,000-acre loss due to marsh deterioration.	64,000 acres in 2030 Impacts similar to the Recommended Plan.	63,200 acres in 2030 26,000-acre loss over base. 1,200-acre loss over FWO, Avoca Island levee causes accelerated marsh loss.	64,000 acres in 2030 25,000-acre loss over base due to marsh deterioration. No change from FWO.
g. Saline Marshes	107,000 acres	69,000 acres in 2030 38,000-acre loss due to marsh deterioration.	67,000 acres in 2030 Impacts similar to the Recommended Plan.	69,000 acres in 2030 38,000-acre loss from base. 100-acre loss from FWO due to accelerated marsh loss caused by Avoca Island levee.	69,000 acres in 2030 38,000-acre loss from base due marsh deterioration. No change from FWO.
h. Atchafalaya Bay Delta	10,100 acres	135,000 acres in 2030 125,000-acre gain due to delta development in Atchafalaya Bay.	135,000 acres in 2030 125,000-acre gain over base. Same as FWO.	131,000 acres in 2030 121,000-acre gain over base. 4,000-acre loss from FWO due to Avoca Island levee. Between 2030 and 2080 an additional 17,000 acres of delta would deteriorate due to the Avoca Island levee.	135,000 acres in 2030 125,000-acre gain over base due to delta development in Atchafalaya Bay.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
i. Fisheries	The overflow system of Lower Atchafalaya Basin Floodway supports a fishery rich in numbers and species. Crawfish harvest averages 15 million pounds yearly. Marshes support an important estuarine fishery. Annual harvest of shrimp is 47.8 million pounds; menhaden is 173 million pounds.	Fisheries productivity would decline from present due to loss of aquatic habitat because of sedimentation and lowering of water levels. Agriculture would increase sediments and pesticides in the aquatic system. Crawfish maximum sustainable yield would drop 39 percent from present.	Impacts similar to the Recommended Plan.	Overall fishery productivity would be lowest with this plan. Sedimentation would destroy thousands of acres of aquatic habitat in the Lower Atchafalaya Basin Floodway and severe water quality problems would occur. Additional agriculture would increase pesticides and sediments, which would reduce fisheries. Crawfish maximum sustainable yield would drop 48 percent from present. Avoca Island levee alinement would cause greatest loss of estuarine fisheries of any plan. Widening of Wax Lake Outlet and construction of 11,610 acres of borrow pits would have benefits described in the EQ plan.	Overall fishery productivity would be less than present, but more than under FWO or NED plan. MU's would increase fishery productivity by flooding more land deeper and longer than under FWO condition, and by preserving permanent aquatic habitat at low water. Crawfish maximum sustainable yield would drop 28 percent from present. Estuarine fishery resources would decrease slightly from present and FWO. Widening Wax Lake Outlet overbank would benefit fisheries by reconnecting 7,800 acres of cypress-tupelo to river and tidal system. 11,950 acres of borrow pits would be created which would enhance fisheries.
j. Endangered and Threatened Species	Sixteen endangered or threatened species occur or might be expected to occur in project area.	Six species would be affected adversely.	Two species would be benefited and two species adversely affected.	Same as FWO.	Two species would be benefited and two species adversely affected.
k. Rookeries	Numerous rookeries occur in the project-affected area.	A number would disappear due to decline in feeding habitat for birds that use them.	Impacts similar to the Recommended Plan.	No protection by easements. Least feeding habitat of any plan would be preserved. Recreational impacts same as the EQ Plan. Clearing would cause increased pesticide pollution in aquatic areas which would adversely impact birds. Channel training of the Lower Atchafalaya River could disrupt several sites.	Five hundred acres of rookeries would be protected by special easements. Environmental easements and MU's would preserve feeding habitat for birds. Recreation features would increase public use, causing increased harassment of birds during nesting. In addition, channel training of the Lower Atchafalaya River could disrupt several sites.
l. Wildlife	A great variety of wildlife exists throughout the project area.	A highly significant decrease in wildlife would occur due to destruction and degradation of forests, marshes and aquatic habitats due to clearing for agriculture, sedimentation, and levee raising.	Impacts similar to the Recommended Plan.	A highly significant decrease in wildlife would occur due to loss of forestland in the Lower Atchafalaya Basin Floodway and backwater area, marsh deterioration and direct construction impacts.	A slight decrease in wildlife would occur due to marsh deterioration, and direct construction impacts. However, there would be a gain in wildlife over FWO conditions.
3. Air Quality	Quality is generally good except near industrial facilities.	Quality would decrease as development and agricultural expansion spread.	Existing quality would be preserved.	Quality would deteriorate throughout the area but not as much as under FWO.	Existing quality would be preserved.
4. Water Quality	River water is high in suspended sediments, dissolved oxygen and nutrients. Overbank areas experience low dissolved oxygen levels during much of the year. Nutrients are sufficiently available within the lower floodway for complete bacterial metabolism of organic matters. Areas outside of floodway have higher dissolved oxygen and more phytoplankton production.	Water quality in overbank areas would deteriorate as average levels and circulation decrease. Further sedimentation would cause even lower dissolved oxygen. Increases in agriculture and industrial would lead to potential problems of pesticide and heavy metal concentrations.	Impacts similar to the Recommended Plan.	Channel training and outlet flow concentration through the Lower Atchafalaya River would lower flowline. Absence of MU's, together with other features, would reduce overbank water supplies. Avoca Island levee extension would limit freshwater input to Terrebonne marshes, but diversion structure(s) could compensate for this effect.	MU's would maintain desirable water levels and flow patterns. Sedimentation would be reduced by distributary realinement. Environmental easements would prevent water quality problems associated with agricultural and industrial development. Possible flow distribution between Wax Lake Outlet and Lower Atchafalaya River, along with channel training, would result in lessened overbank flow into adjacent marshes.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
5. Esthetic Values	Value high due to semiwilderness nature of area despite oil and gas activities.	Quality would continue to deteriorate as sedimentation continues to fill in open water areas and as oil and gas activity expands and logging accelerates.	Impacts similar to the Recommended Plan.	Even greater degradation of esthetic values in Lower Atchafalaya Basin Floodway and Atchafalaya Bay would occur than under FWO. Construction of Avoca Island levee through center of developing delta would degrade esthetics.	Values would decline from present as sedimentation, and oil and gas activities continue and logging accelerates. Decline would be far less than under FWO. Real estate features would preserve forests in Lower Atchafalaya Basin Floodway. Overall plan would benefit esthetic values, except channel training along the Lower Atchafalaya River and Wax Lake Outlet would degrade esthetics.
6. Open and Green Space	Largest contiguous, roadless, semiwilderness in Louisiana.	Amount and quality of open space in Lower Atchafalaya Basin Floodway would decrease while need for such spaces grew. Rising water levels would preserve open space in backwater area. Continued oil development would decrease quality.	Open space preserved in Lower Atchafalaya Basin Floodway and backwater area.	Greatest amount of open space, both in Lower Atchafalaya Basin Floodway and backwater area, would be lost.	Open space preserved in Lower Atchafalaya Basin Floodway and backwater area.
7. Lakes and Streams					
a. Riverine and Distributary Waters	31,100 acres	32,000 acres in 2030 1,000-acre gain over base due to erosion of Atchafalaya River.	33,000 acres in 2030 2,000-acre gain over base due to construction and erosion. 1,000-acre gain over FWO due to construction.	32,000 acres in 2030 1,000-acre gain from base due to erosion. Same as FWO.	32,000 acres in 2030 1,000-acre gain from base due to erosion. 100-acre gain from FWO due to construction.
b. Bayous, Canals, and Borrow Pits	38,000 acres	51,000 acres in 2030 13,000-acre gain due mostly to levee raising and some to marsh deterioration.	51,000 acres in 2030 13,000-acre gain over base mostly due to levee raising and some to marsh deterioration. 100-acre gain over FWO due to construction impacts.	53,000 acres in 2030 15,000-acre gain over base due mostly to levee raising and some marsh deterioration. 1,700-acre gain over FWO due to construction impacts of the Avoca Island levee extension.	51,000 acres in 2030 12,700-acre gain over base due mostly to levee raising and some marsh deterioration. 200-acre gain over FWO due to construction impacts.
c. Headwater Lakes	18,200 acres	1,900 acres in 2030 16,300-acre loss due mostly to sedimentation and lowering of water levels.	2,200 acres in 2030 Impacts similar to the Recommended Plan.	1,800 acres in 2030 16,400-acre loss from base due to sedimentation and falling water levels. 100-acre loss from FWO.	2,200 acres in 2030 16,000-acre loss from base due to sedimentation and falling water levels. 300-acre gain over FWO.
d. Backwater Lakes	42,000 acres	34,000 acres in 2030 8,000-acre loss due mostly to sedimentation and falling water levels and 3,900 acres reclassified as cropland lakes due to clearing.	38,300 acres in 2030 3,700-acre loss from base due to sedimentation and falling water levels. 4,300-acre gain over FWO due mostly to environmental easements.	33,400 acres in 2030 8,600-acre loss from base due to sedimentation and falling water levels and about 4,600 acres reclassified as cropland lakes due to clearing.	38,300 acres in 2030 3,700-acre loss from base due to sedimentation and falling water levels. 4,300-acre gain over FWO due mostly to environmental easements.
e. Cropland Lakes	30 acres	4,100 acres 4,070-acre gain due to land clearing.	30 acres in 2030 Retains present conditions.	4,900 acres in 2030 4,870-acre gain over base due to land clearing. 800-acre gain over FWO due to land clearing.	30 acres in 2030 Retains present conditions.
f. Brackish and Saline Marsh, Bayous, and Canals	Brackish bayous 6,200 acres. Saline bayous 6,100 acres.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Increase due to erosion of brackish and saline marsh.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Same as FWO.	Brackish 8,300 acres by 2030. Saline 7,400 acres by 2030. Saline same as FWO, additional brackish marsh deterioration caused by Avoca Island extension would lead to increase of 200 acres of brackish bayous.	Brackish 8,100 acres by 2030. Saline 7,400 acres by 2030. Increase due to erosion of brackish and saline marsh.

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
g. Marsh Ponds and Lakes	Fresh 87,600 acres. Brackish 55,200 acres. Saline 64,400 acres.	Same as the Recommended Plan.	Same as the Recommended Plan.	Fresh 142,400 acres in 2030. Brackish 76,300 acres in 2030. Saline 99,100 acres in 2030. Gains slightly larger than FWO. Construction of Avoca Island levee would increase formation of ponds.	Fresh 141,600 acres in 2030. Brackish 75,300 acres in 2030. Saline 99,000 acres in 2030. 54,000-acre gain of fresh, 20,1[illegible] acre gain of brackish, 34,600-acre gain of saline due to "natural" deterioration of marsh.
h. Bays and Open Gulf	Fresh bays 200,000 acres. Brackish bays 58,900 acres. Saline bays 53,800 acres. Shallow gulf 804,000 acres.	Fresh bays 75,700 acres in 2030. Others same as base. Loss of 124,300 acres of fresh bays due to growth of delta in Atchafalaya Bay.	78,900 acres of fresh bays in 2030. Impacts similar to the Recommended Plan.	79,700 acres of fresh bays in 2030. Others same as base. Loss of 120,300 acres of fresh bays due to growth of delta in Atchafalaya Bay.	78,900 acres of fresh bays in 2030. Others same as base. Loss of 121,100 acres of fresh bays due to growth of delta in Atchafalaya Bay.
8. Wildlife Refuges and Management Areas	One national refuge and 11 state management areas in project area. Two in project-affected area.	The two management areas in the project-affected area would increase in size and terrestrial habitat quality due to sedimentation and plant succession. Aquatic habitat quality would decrease due to pollution.	Public use would be increased in the two areas in project-affected area.	Public use would be increased as in the EQ plan. Channel alinement of Avoca Island levee could destroy 4,000 acres of newly developed delta in Atchafalaya Delta Management Area by 2030 and an additional 17,000 acres by 2080.	Public use would be increased in the two areas in project-affected area.
9. Natural and Scenic Streams	Bayou Penchant	Scenic quality could decrease or change as water levels rise due to rising Atchafalaya River flowline.	Same as FWO.	Avoca Island levee would prevent rising water levels and possibly help preserve existing scenic quality.	Scenic quality could decrease or change as water levels rise due to rising Atchafalaya River flowline.
III. PLAN EVALUATION					
A. Contribution to National Planning Objectives/Accounts					
1. National Economic Development[2]					
a. Tangible Annual Benefits (Nonflood Control)		No contribution.			
(1) Recreation Development			$17,273,000	$16,551,000	$16,551,000
(2) Other Nonflood Control Features			$ 1,710,000	$ 0	$ 2,108,000
(3) Total Nonflood Control			$18,983,000	$16,551,000	$18,659,000
b. Tangible Annual Costs (Nonflood Control)		No contribution.			
(1) Recreation Development			$ 2,029,000	$ 2,055,000	$ 2,029,000
(2) Other Nonflood Control Features			$16,509,000	$ 0	$16,479,000
(3) Total Nonflood Control			$18,538,000	$ 2,055,000	$18,508,000

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
c. Net Benefits (Nonflood Control)		No contribution.			
(1) Recreation Development			$15,244,000	$14,496,000	$14,522,000
(2) Other Nonflood Features			-$14,799,000	$ 0	-$14,371,000
(3) Total Nonflood Control			$ 445,000	$14,496,000	$ 151,000
d. Benefit-Cost Ratio (Nonflood Control)		No contribution.			
(1) Recreation Development			8.5 to 1	8.1 to 1	8.2 to 1
(2) Other Nonflood Control Features			0.10 to 1	--	0.13 to 1
(3) Total Nonflood Control			1.02 to 1	8.1 to 1	1.01 to 1
2. Environmental Quality					
a. Management, Protection, Enhancement, or Creation of Areas of Natural Beauty and Enjoyment		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
b. Management, Preservation, or Enhancement of Especially Valuable or Outstanding Archeological, Historical, Biological, and Geological Resources and Ecological Systems		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
c. Enhancement of Quality Aspects of Water, Land, and Air by Control of Pollution or Prevention of Erosion and Restoration of Eroded Areas		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
d. Avoiding Irreversible Commitment of Resources to Future Uses		Negative contribution.	Highly positive contribution.	Same as FWO.	Highly positive contribution.
3. Social Well-Being		Net negative contribution.	Positive contribution in floodway; negative contribution in backwater.	Slightly negative contribution.	Positive contribution in floodway; negative contribution in backwater.
4. Regional Development		No net appreciable contribution.	Same as FWO.	Positive contribution	No net appreciable contribution.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
B. Contribution to Specific Planning Objectives					
1. Flood Control-Implement a Flood Control System That Will Safely Pass the Project Flood to the Gulf of Mexico in an Environmentally-Sound Manner. Reduce to the Maximum Extent Practical the Deposition of Sediments That Reduce the Ability of the Floodway to Pass the Project Flood.		Will pass the project flood with consequential damages.	Will accomplish objective upon resolution of backwater flooding problem.	Will safely pass the project flood with more environmental damages than FWO.	Will accomplish objective upon resolution of backwater flooding problem.
2. Natural Environment--Retain and Restore the Unique Environmental Features of the Floodways and Maintain or Enhance the Long-Range Productivity of the Wetland and Woodlands.		Does not accomplish objective.	Of all alternative plans considered, most nearly achieves the objective.	Same as FWO.	Of all alternative plans considered, most nearly achieves the objective.
3. Agricultural Activities and Mineral Development--Allow Agricultural Activities and Mineral Development Provided Such Activity Does Not Interfere with the Goals Relative to Flood Control or the Natural Environment.		Does not accomplish objective.	Same as FWO.	Same as FWO.	Does not accomplish objective.
4. Delta Formation--Maximize Natural Delta Formation in Atchafalaya Bay While Providing for Navigation and Passage of the Project Flood.		Accomplishes objective.	Same as FWO.	Does not accomplish objective.	Accomplishes objective.
5. Public Accessibility Maximize Public Opportunity to Observe and Utilize the Fish and Wildlife Resources of the Floodway.		Does not accomplish objective.	Optimizes public access to aquatic resources. Provides more limited terrestrial access.	Does not meet specific intent of objective but optimizes public access to aquatic resources.	Optimizes public access to aquatic resources. Provides more limited terrestrial access.
C. Plan Response to Associated Evaluation Criteria					
1. Acceptability		Unacceptable to flood control and environmental interests alike.	Unacceptable to many basin landowners, hunting clubs. Acceptable to environmental interests.	Unacceptable to environmental and commercial fishing interests.	Acceptable to most basin landowners, commercial fishing interests, and Terrebonne Parish. Unacceptable to some hunting clubs.
2. Completeness		Assumes some state or local entity would implement flood control actions to pass project flood in the absence of Federal action.	Assumes preauthorization and post-authorization moratorium on land clearing.	Complete	Assumes preauthorization and post-authorization moratorium on land clearing.

TABLE B-5-1 (CONTINUED)

SUMMARY COMPARISON OF ALTERNATIVE PLANS

Item	Base (1980)	Future Without Project (FWO)	Environmental Quality (EQ) Plan	National Economic Development (NED) Plan	Recommended (R) Plan
3. Effectiveness		Effective for project flood conveyance (see "Completeness" above).	Effective for flood conveyances and environmental protection.	Effective for project flood conveyance.	Effective for flood conveyances and environmental protection.
4. Certainty		Certainty is low with respect to flood control and moderate regarding environmental quality.	Certainty is high.	Certainly is high with respect to flood control and low with respect to environmental quality.	Certainty is high.
5. Geographic Scope		Scope is national in nature.	Same as FWO.	Same as FWO.	Scope is national in nature.
6. NED Benefit-Cost Ratio (Overall Nonflood Control)			1.02 to 1	8.1 to 1	1.01 to 1
7. Reversibility		Irreversible.	Reversible to a moderate degree.	Same as FWO.	Reversible to a moderate degree.
8. Stability		Same as the Recommended Plan.	Medium to high	Same as FWO.	Because of the dynamic nature of the basin ecosystem, the overall stability associated with this condition falls in the median percentile.
D. Rankings of Plans					
1. NED Objective			(2)	(1) NED Plan	(3)
2. EQ Objective			(1) EQ Plan	(3)	(2)
3. Social Well-Being Objective			(1)	(2)	(1)
4. Regional Development Objective			(2)	(1)	(2)
IV. IMPLEMENTATION RESPONSIBILITY					
A. Total First Cost Flood Control and Nonflood Control 3/					
1. Federal			$ 999,903,000	$936,006,000	$936,797,000
2. Non-Federal 4/			15,938,000	1,875,000	51,209,000
3. Total			$1,105,841,000	$937,881,000	$988,006,000
B. Annual Operation and Maintenance Cost (Flood Control and Nonflood Control) 3/					
1. Federal			$ 14,439,000	$ 14,673,000	$ 15,606,000
2. Non-Federal			433,000	383,000	433,000
3. Total			$ 14,872,000	$ 15,056,000	$ 16,039,000

1/ For purposes of comparing impacts of the detailed plans on an equal basis, the Avoca Island levee extension and five management units were assumed in place. The implementation of only an additional 14,000 feet of the Avoca Island levee would cause minimal impacts.

2/ The benefits and costs presented here are the nonflood control values applicable to each plan alternative. The flood control aspects of each plan are considered a part of the overall Mississippi River and Tributaries project and as such are not subject to incremental evaluation.

3/ Based on construction of an additional 14,000 feet of the Avoca Island levee for the NED plan; does not include interest during construction for any plan.

4/ Includes credit for flood control and/or basic environmental easements over 150,000 acres of state-owned land.

in the case of the NED plan, these benefits represent 100 percent of the total.

TABLE B-5-2

RECREATION DEVELOPMENT BENEFITS AS A PERCENT OF TOTAL NONFLOOD CONTROL BENEFITS

	NED	EQ	Recommended
Total Annual Nonflood Control Benefits	$16,551,000	$18,983,000	$18,659,000
Annual Recreation Development Benefits	$16,551,000	$17,273,000	$16,551,000
Recreation Development As a Percent of Total	100	91	89

B.5.7. The fact that the recreation development feature accounted for most of the total benefits suggests that this feature should be considered as a separable feature and evaluated incrementally. In the case of the NED plan, the evaluation of nonflood control features has produced an incremental evaluation of the recreation development feature. This is because it represents the only nonflood control feature of the NED plan. In addition to accounting for approximately 90 percent of total benefits, the fact that these benefits could be achieved by construction of only those features associated with the recreation development plan adds significantly to the case for incremental evaluation. Fee purchase of approximately 1,500 acres and construction of facilities on these acres would be the only requirements for the plan to be effective. Purchase of additional real estate easements to provide public access or to protect fish and wildlife habitat would not be necessary for the proposed recreation features to achieve the stated level of benefits.

B.5.8. Table B-5-3 presents an incremental evaluation of the recreation development plan, assuming all other nonflood control features in place. As was suggested by the high percentage of total benefits represented by recreation, the incremental evaluation produced a highly favorable economic justification. (It should be noted that the 1,500 acres required for construction of recreation facilities would result in only very minor losses to timber and recreational hunting. For purpose of incremental analysis, this would slightly increase the cost of the development plan.) Table B-5-4 presents an evaluation of the remaining nonflood control features exclusive of the development plan. With annual benefits approximately

90 percent less, while still carrying the majority of the annual costs (approximately 89 percent for both the EQ and Recommended Plans), the remaining nonflood control features lacked tangible economic justification.

TABLE B-5-3

INCREMENTAL EVALUATION OF RECREATION DEVELOPMENT ONLY

	NED	EQ	Recommended
Annual Benefits	$16,551,000	$17,273,000	$16,551,000
Annual Costs	$2,055,000	$2,029,000	$2,029,000
Benefit-Cost Ratio	8.1 to 1	8.5 to 1	8.2 to 1

TABLE B-5-4

INCREMENTAL EVALUATION OF NONFLOOD CONTROL FEATURES
EXCLUDING RECREATION DEVELOPMENT

	EQ	Recommended
Annual Benefits	$1,710,000	$2,108,000
Annual Costs	$16,509,000	$16,486,000
Benefit-Cost Ratio	0.10 to 1	0.13 to 1

B.5.9. The inclusion of the recreation facilities development in the overall evaluation of nonflood control features results in an economically justified plan in tangible economic terms. When included, the EQ and Recommended Plans yield benefit-cost ratios of 1.02 to 1 and 1.01 to 1, respectively. In their absence, the EQ and Recommended Plans fall to 0.10 to 1 and 0.13 to 1, respectively. These other nonflood control features, however, have been included in the Recommended Plan because of the significant contribution they make to the EQ account. While providing only limited tangible economic benefits, these features are considered justified on the basis of their intangible benefits and their contributions to the study goal of environmental protection.

B.5.10. Table B-5-5 summarizes the costs, authorization status, and purposes of the features included in the Recommended Plan. Plate B-21 delineates the features geographically.

TABLE B-5-5

COSTS, AUTHORIZATION STATUS, AND PURPOSE OF FEATURES

RECOMMENDED PLAN
ATCHAFALAYA BASIN STUDY

Feature	Cost	Requires Congressional Authorization		Purpose				Remarks
		Yes	No	Flood Control	Environmental Quality	Public Access	Recreation	
Old River Control Structure, maintain present operation	*No additional*		X	X				
Modification of features to pass the project flood	$446,681,000		X	X				
Bank stabilization	$104,950,000		X	X				
Main channel development[1/]	$64,100,000		X	X				
Sediment control	$31,100,000		X	X				
Management Units	$23,730,000	X			X			
Real Estate Interests								REAL ESTATE: The Recommended Plan includes comprehensive multipurpose easements over 367,000 acres in the Lower Atchafalaya Basin Floodway, excluding developed ridges. In addition, public access rights would be provided in the lower floodway by the State of Louisiana on: 150,000 acres of existing state lands; more than 30,000 acres donated to the state by Dow Chemical Company; and by the fee title purchase of approximately 50,000 acres of lands identified by the state, with Federal cost participation.
Flood Control								
Development Control	$13,781,000	X		X				
Overflow Rights	$5,951,000		X	X				
Environmental	$100,538,000	X			X			
Access	$66,693,000	X				X	X	
Fee (Recreation)	$874,000	X				X	X	
Wax Lake Outlet overbank enlargement (8,000 acres)	$90,500,000		X	X				COST ALLOCATION OF THE REAL ESTATE PLAN:
Outlet Works	$10,830,000		X	X				Flood Control $19,732,000; Environmental Protection 100,538,000; Public Access 66,693,000; Recreation (1,500 acres) 874,000; Total $187,837,000
Backwater Flooding East of Morgan City[2/]	--		X	X				
Recreational Development	$19,169,000	X					X	
Freshwater Structures	$8,109,000		X		X			
Canal Closures and Circulation Improvements	$1,000,000	X			X			
TOTAL[3/]	$988,006,000[4/]							

[1/] Includes channel training below Morgan City at $11,650,000.

[2/] Implementation after completing additional engineering and biological studies.

[3/] Does not include interest during construction.

[4/] Federal cost - $936,797,000; Non-Federal cost - $51,209,000 (see Table 9).

DEPARTMENT OF THE ARMY
VICKSBURG DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60
VICKSBURG, MISSISSIPPI 39180

REPLY TO
ATTENTION OF:

LMKPD-S

30 OCT 1981

SUBJECT: Atchafalaya

Commander, New Orleans District
ATTN: LMNPD-C

1. Reference letter LMNPD-C, 7 Oct 81, subject as above.

2. The inclosed data is furnished for input into subject study. It should be noted that the data is applicable to the Red River Backwater Area only and is based on readily available information.

3. Questions concerning the methodologies, assumptions, and/or results should be directed to Mr. Samuel P. Christian, FTS 542-5421.

1 Incl
as

SAMUEL P. COLLINS, JR.
Colonel, Corps of Engineers
Commanding

ATTACHMENT 1

ATCHAFALAYA BASIN STUDY
RED RIVER BACKWATER AREA

ALTERNATIVES STUDIED

1. The Vicksburg District has developed data concerning only the proposed modification of flows through the Old River Control Structure during the months of May, June, and July. Flows would be adjusted from the authorized 70/30 split in an attempt to keep stages at Acme, Louisiana, from exceeding 45 feet, National Geodetic Vertical Datum (NGVD), during those months previously mentioned; however, variations must be accomplished within the overall constraints of maintaining the 70/30 percent distribution on an annual basis.

HYDRAULIC CONSIDERATIONS

2. An analysis was conducted of the newly proposed Old River Control Structure operation plan to define the frequency and duration of flooding of major gaging locations in the Red River Backwater Area. The newly proposed plan involves the ORCS being operated to maintain a 70/30 distribution for the months of January through April, and August through December. For the months of May, June, and July the ORCS will be operated to maintain the Acme stage at or below 45 feet, NGVD, as long as the 18.3 feet of head differential is not exceeded on the ORCS and the structure operation does not force another floodway to be operated (i.e., Morganza or Bonnet Carre').

3. The analysis concluded that the base condition frequency curve for all gages other than Acme, Louisiana, and Jonesville, Louisiana, appropriately reflected this new alternative. The hydrographs for the original 45-foot alternative are appropriate for the new plan for the May, June, and July time period.

ECONOMIC CONSIDERATIONS

4. Table 1 provides a summary of benefits obtainable by modification of the 70/30 flow distribution through Old River Control Structure during the months of May, June, and July. The methodologies utilized were identical to those used in the evaluation of the previous alternatives involving modification of flow distributions. Price levels are 1981, and the interest rate used was 7-5/8 percent.

5. Implementation of the 70/30 modified alternative results in reduced annual flooding of cleared lands from 98,300 acres under the present operation to 95,000 acres with the modified alternative. This reduction translates into an average annual benefit of $1,409,000 in the Red River Backwater Area.

6. A copy of our previous submission is inclosed (Attachment 3) for your convenience.

TABLE 1
ATCHAFALAYA BASIN STUDY AVERAGE ANNUAL BENEFITS
BY AREA AND BENEFIT CATEGORY
ALTERNATIVE 70/30 MODIFIED

Area	Benefits by Category						Total Average Annual Benefits	Percent of Total
	Flood Damages Prevented				Intensification			
	Agricultural Crops	Agricultural Noncrop	Road and Bridge	Structures	Increased Net Returns	Land Clearing		
Sicily Island (Plan 6)	28,700	1,600	6,900	0	37,800	27,800	102,800	7.3
Below Larto Lake	4,000	100	800	0	29,700	0	34,600	2.4
Below Red River (Unprotected)	125,700	8,000	10,100	0	293,000	9,800	446,600	32.7
Below Red River (Levee B)	18,700	1,000	2,100	0	67,600	0	89,400	6.3
Bushley Bayou (Plan 7)	47,800	3,300	3,800	0	64,200	0	119,100	8.4
Bushley Bayou (Excluding Plan 7)	2,700	600	700	0	3,000	0	7,000	.5
Boeuf River (Reach 5)	27,200	0	0	0	51,100	0	78,300	5.6
Tensas River (Reach 3)	0	0	0	0	0	0	0	0.0
Tensas River (Reach 4)	22,600	0	0	0	154,600	0	177,200	12.6
Ouachita River (Reach 7)	3,800	0	0	0	15,000	0	18,800	1.3
Upper No Reach	8,400	0	0	0	99,300	0	107,700	7.6
Lower No Reach	47,300	2,500	2,600	0	175,500	0	227,900	15.3
Total	336,900	17,100	27,000	0	990,800	37,600	1,409,400	
Percent of Total	23.9	1.2	1.9	0.0	70.3	2.7	100.0	100.0

ENVIRONMENTAL CONDITIONS

7. The Red River Backwater Area, located in east-central Louisiana, extends from the Mississippi River westward for approximately 40 miles to the hill line west of the Black River and west of Catahoula Lake along Little River, and from the head of the Atchafalaya Basin north for approximately 100 miles to the latitude of Monroe, Louisiana, encompassing approximately 856,000 acres. Located in the Southern Mississippi Alluvium, this flat lowland area is characterized by flood plains and meander belts and intricate systems of interlacing streams, sloughs, lakes, and swamps. The backwater area is protected from direct overbank flooding of the Arkansas and Mississippi Rivers by the Arkansas and Mississippi Rivers levees from the latitude of Pine Bluff, Arkansas, to the Old River Closure and Control Structure. It is subjected to Mississippi backwater flooding and both overflow and backwater flooding from the Red and Black Rivers; however, flooding has been reduced in extent and duration throughout those areas of the basin where flood control works have been completed.

8. The area's fertile alluvial soil base, mild climate, abundant rainfall, and flat terrain are conducive to high agricultural productivity. Land clearing and draining for agricultural purposes have severely reduced the vast tracts of bottom-land hardwoods and wetlands that once occurred in this area. With the exception of Federal and state-owned wildlife refuges and management

areas, only small remnants of the once vast tracts currently remain. Major vegetative types are described as forested and nonforested. The nonforested category consists of cropland and pasture. The forested category is composed of major timber types which consist of bottom-land hardwoods, bald cypress-tupelo gum and cottonwood-willow-sycamore. The area has large areas of wetlands and open water. The two leading parishes in lake surface acreages are LaSalle (16 water bodies with 17,383 surface acres) and Avoyelles (50 water bodies with 10,270 surface acres). Catahoula and Concordia Parishes have the largest number of water bodies with 80 and 74, respectively. The largest lake within the area is Catahoula Lake which ranges from 5,000 to 25,000 acres. Overall water quality trends within the backwater area (bottom-land parishes) show a decline over the years and are attributable primarily to increased agricultural activity in the basin. Water quality in most of the small lakes in the bottom-land area has already declined to very poor and to only moderate in the remainder. Parameters indicating a decline in water quality are: increases in turbidity, suspended solids, plant nutrients (ammonia, nitrate, phosphate, etc.); pesticide residues; and decreases in dissolved oxygen.

SOCIAL, CULTURAL, AND
ECONOMIC CONDITIONS

9. Thorough discussions of the social, cultural (see Attachment 1), and economic conditions are presented in other portions of this report and will not be reiterated in this section.

Open Water and Wetlands

10. As previously stated, the backwater area is rich in open water areas and wetlands. The largest, Catahoula Lake, is known for its nationally important wildlife habitat (waterfowl habitat, in particular). It is a major wintering area for waterfowl in the Mississippi Flyway. Due to its extreme seasonal water fluctuations, other water-based recreation and fishing are somewhat limited. Fish populations and standing crop values in all the lakes are directly correlated to water quality. Important wetland data for the Red River Backwater Area was developed in the 1975 inventory of the Ouachita River Basin using the criteria set forth in U. S. Fish and Wildlife's Circular 39. In this inventory, wetland types, their general location, and acreages within the basin were determined. This type of information is important to wildlife biologists, agricultural planners, and other individuals interested in land use changes and/or wetland preservation. It is also important that the many values of wetland areas be understood. Some of the basic major functions and values of wetlands are: (1) provide fish and wildlife habitat; (2) increase recharge of ground water; (3) retain surface water; (4) stabilize surface runoff; (5) reduce or prevent erosion; (6) produce timber; (7) create firebreaks; (8) provide outdoor laboratories for students, scientists, and photographers; and (9) provide for production of cash crops, such as crawfish, furs, and bait. Wetlands are used extensively for all waterfowl species

inhabiting the basin. In addition, 20 to 22 of Louisiana's 23 species of fur and game animals utilize wooded wetland types 1, 6, and 7 as all or part of their essential habitat.

11. In the Louisiana portion of the Ouachita Basin, wetland types 1 and 7 made up the majority of the wetland acreages, comprising 58 and 16 percent, respectively. Avoyelles, LaSalle, and Concordia Parishes contained the most wetland acres with 17, 17, and 13 percent, respectively, of the total Louisiana wetland areas studied. Parishes ranking first in wetland acreages for types 1 through 7 for the Louisiana portion of the basin study were type 1, Avoyelles; type 2, Ouachita; type 3, Tensas; type 4, Ouachita; type 5, Catahoula; type 6, LaSalle; and type 7, Avoyelles. The single most valuable wetland complex in the Louisiana portion of the basin study was Catahoula Lake and surrounding areas which totaled about 25,000 acres of wetland types 1 through 7.

Fishery Resources

12. Although the backwater area is experiencing declining water quality, its aquatic resources continue to be important natural assets. The complex systems of lakes, sloughs, bayous, streams, river channels, and associated wetlands result in highly diverse freshwater environments. These areas provide suitable spawning, nursery, feeding and escape habitat to a wide variety of aquatic organisms. These organisms are important components of the food web. In addition to their natural functions, some species are also important from a recreational and commercial standpoint. Fisheries standing

crop data for lakes with the backwater parishes are presented in Table 2. The standing crop data presented do not include crawfish data. Crawfish are of recreational and commercial importance during the spring high water season usually ending during May and June. In the natural environment, crawfish are a component in the diets of both terrestrial and aquatic predators.

Annually Flooded Forest Lands

13. Flood plain forests are among the highest in primary productivity of any ecosystem in the southeast (Brown et al., 1978). Conner and Day (1976) reported that litterfall in bottomland and cypress-tupelo stands in Louisiana exceeded most values reported for warm temperate upland forests. These are the flood plain's primary producers and the source of much of the detritus on the flood plain and in the rivers. Food chains on the flood plain floor are detritus-based. This detrital organic matter supplied to invertebrate life forms the basis for food chains that feed fish, birds, and mammals. Holder (1971) found flood plain productivity to be 15 to 20 times that of the river channel (crayfish at densities of 19 per 100 square meters formed one-third of the flood plain animal biomass).

14. The annually flooded forests of the backwater area and their associated wildlife species are adapted to and thrive under these conditions. Overstory species include overcup oak, Nuttall oak, honey locust, hackberry, bitter

TABLE 2

LAKE FISHERIES STANDING CROP DATA FOR PARISHES WITHIN RED RIVER BACKWATER AREA

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Avoyelles		
12-2[a]		
Bay Ronde	5	150
Big Bend	5	150
Blue Hale Lake	35	175
Cross Lake (complex)	165	200
Dry Cypress Lake	10	100
Duck Lake	130	125
Grand Lake No. 1	245	210
Grand Lake No. 2	30	200
Grassey Lake	80	200
Jimmy Lake	40	150
Lac Amelia	75	175
Lake Calebasse	30	150
Lake Didier	75	180
Lake Madam Lee	15	150
Lake Marna	10	150
Lake Poisson Arme	25	175
Lake Volais (complex)		35
Long Lake No. 1	45	190
Long Lake No. 2	25	190
Long Lake No. 3	10	180
Marais a Roche	60	200
Martin Bay	70	210
Morel Lake	65	205
Mouiller a'Yor	15	180
Muscle Lake	15	180
Nichols Lake	80	200
Petitie Bay	20	150
Red River Bay	85	210
Shark Bay	10	180
Smith Bay (complex)	315	220
Westcut Lake	95	210
12-3		
Bayou du Lac	1,235	110
Lake Ambrose	20	110
Lake Beceros	10	120
Avoyelles (cont)		
12-3 (cont)		
Lake Bois Sec	25	140
Lake Claire	50	180
Lake Ophelia	300	210
Lake Perlon du Chat	150	200
Lake St. Agnes	320	240
Lake Soller	40	180
Little Lake Soller	5	110
Old River	500	200
Petitie Lac du Grande Prelon	40	
Spring Bayou (complex)		5,290
12-4		
Johnson Lake	80	180
12-10		
Cannon Lake	10	110
Gin Lake	70	140
Grimes Lakes	10	110
Reynolds	140	180
Schampinol Lake	55	140
Total	10,270	
Caldwell		
12al-4		
Brandon Lake	22	110
Brushy Lake	205	200
Eagle Lake	30	180
Ferrand Lake	50	110
Horseshoe Lake No. 1	80	120
Horseshoe Lake No. 2	110	130

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Caldwell (cont)		
12a1-4 (cont)		
Humble Lake	70	110
Relverton Lake	20	120
Swim Lake	40	150
Volman Lake	90	170
Wheeler	20	180
12al(e)-1		
Bayou LaFourche	1,000	140
Crew Lake	40	180
Davis Lake	185	200
Hinze Lake	20	140
Locust Thicket Lake	25	130
Long Lake	205	190
Old Channel	60	170
Sawyer Pond	65	160
Wild Boar Lake	10	140
12al(e)-2B		
Long Lake	10	110
Morenyo Lake	95	150
Open Lake	8	110
Short Lake	5	110
Total	2,465	
Catahoula		
12-5		
Big Hole	8	120
Mitten Lake	10	110
Swan Lake	35	140
12-6		
Burr Lake	8	110
California Bayou	22	120
Eagle Nest Lake	18	130
Five Point Lake	18	130
Hibbs Lake	20	120
Maknockanut Lake	55	180
Open Brake	20	140
Parker Lake	20	140
Snaggy Lake	195	195
Willow Lake	140	190

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Catahoula (cont)		
12-6 and 12-7		
Shad Lake	1,140	240
12-7		
Babays Lake	50	195
Birds Nest Lake	105	200
Devils Lake	18	180
Fish Lake	8	110
Fisher Lake	200	180
Larto Lake	2,100	250
Wash Lake		180
12-11		
Horseshoe Lake	10	140
Lorran Lake	33	150
Round Lake	55	160
Snaggy Lake	5	120
Whites Lake	35	110
Willow Lake	12	140
Wise Lake	45	150
12al-1		
Bens Lake	50	160
Billys Bayou Lake	5	110
Black Bayou Lake	6	110
Brooks Lake	25	120
Buck Lake	5	110
Cash Lake	22	140
Coon Lake	8	110
Dead Lake	5	110
Ditto Lake	25	110
Fool River	260	190
George Lake	5	110
Green Lake	8	110
Guthrie Lake	80	120
Lake Louis	1,000	190
Little Bens Lake	10	110
Mean Lake	260	180
Ruffee Lake	40	170
Sheppards Lake	8	110
Well Lake	40	140
York Lake	18	120
12al-2		
Dry Lake	12	110
Sargent Lake	80	180
Town Lake	30	110

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Catahoula (cont)		
12al-3		
Big Lake	70	150
Stafford Lake	35	140
12al(e)-1		
Barnett Lake	35	140
Brush Lake	33	130
Cypress Lake	20	105
Dalley Lake	22	145
Rock Lake	45	150
Sunk Lake	8	110
12al(f)-1		
Black Lake	8	105
Half Mile Lake	20	140
Hoover Lake	85	150
Knockunat Lake	25	135
Middle Lake	15	120
Pool Lake Bayou	40	135
River Lake	20	120
Sunflower Lake	10	110
Trap Lake	15	105
Twomile Lake	35	110
Willow Lake	6	105
12al(g)-1		
Black Lake No. 1	3	110
Black Lake No. 2	8	110
Dempsey Lake	38	140
Fish Lake	5	110
Long Lake	85	170
Rhinehart Lake	20	140
Round Lake	20	130
Sandy Lake	45	155
Tew Lake	185	230
Wallace Lake	245	230
Total	7,608	
Claiborne		
12al(d)-4		
Callender Pond	8	100
Clampit Lake	20	120
Claiborne (cont)		
12al(d)-5		
Goodwin Lake	36	125
J. R. King Lake	35	130
Lake Claiborne	6,400	150
Lake Herman	22	120
Moreland Lake	20	110
12al(d)(1)-1		
Corney Lake	1,900	110
Total	8,441	
Concordia		
12-1		
Flat Lake	75	140
Goose Lake	5	130
Grand Bay	208	210
Hog Pen Lake	38	240
Lost Lake	7	180
Lower Sunk Lake	770	210
Moreau Lake	25	200
12-11		
Big Lake	25	190
Donnelly Lake	62	185
Royster Lake	5	140
12al-1		
Chaney Lakes (3)	54	180
Jerry Lake	20	170
Lake Curry	20	170
Patton Lake	64	190
School House Lake	8	170
Upper Sunk Lake	45	210
Welsh Lake	85	200
Whiskey Bayou Lakes (3)		40
Williams Lake	65	195
12al-2		
Bee Lake	40	180
Big Lagoon	20	170
Black Lake No. 1	26	195
Black Lake No. 2	335	205
Blue Lake No. 1	20	195
Blue Lake No. 2	12	190

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Concordia (cont)		
12a1-2 (cont)		
Brickyard Lake	40	195
Brushy Bayou	311	210
Carr Lake	9	170
Cauley Lake	60	160
Clayton Lake	22	150
Clear Lake	5	140
Cocodrie Lake	1,112	240
Concordia Lake	1,000	210
Crowder Lake	12	190
Crouch Lake	5	140
Cypress Lake No. 1	10	170
Cypress Lake No. 2	12	180
DeArmond Lake	21	180
Dobbins Lake	5	170
Dry Lake	14	110
Duck Roost Lake	2	100
Emiline Lake	25	180
Flat Lake	6	110
French Lake	50	190
Gin Lake No. 1	10	170
Gin Lake No. 2	12	170
Grandma Lake	10	160
Jenkins Lake	22	150
Lake St. John	2,100	210
Little Gin Lake	8	180
Little Lagoon	16	170
Little Wallace Lake	12	170
Lower Clear Lake	6	140
Mack Lake	40	170
Myers Lake	12	160
Ox Lake	50	180
Pandora Lake	12	140
Parish Lake	12	140
12a1-2		
Round Lake No. 1	95	200
Round Lake No. 2	20	195
Round Lake No. 3	10	190
Shanty Lake	45	180
Shavings Lake	8	140
Snag Lake	10	140
Tronsel Lake	8	130
Turtle Lake	110	170
Twin Lake	40	140
Upper Clear Lake	6	110
Wade Lake	32	180

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Concordia (cont)		
12a1-2 (cont)		
Wallace Lake	10	120
Whitehall Lake	45	135
Total	7,629	
Franklin		
12al(e)-2E		
Don Lake	5	125
Dry Lake	12	200
Fool River Lake	18	250
Forest Lake	48	225
Goose Lake	38	225
Guice Lake	15	200
Hicktom Lake	10	200
Horseshoe Lake	25	225
Mullen Lake	6	150
Plum Thicket Lake	18	175
Sims Lake	25	180
Turkey Creek Lake	3,000	
Willis Lake	14	170
12al(f)-3		
Batese Lake	3	150
Beaver Lake	25	225
Beeler Lake	20	225
Big Cow Lake	19	200
Board Tree Lake	5	175
Calf Lake	3	175
East Johnson Lake	3	175
East Lake	15	225
Green Lake	21	230
Hog Lake	15	200
Johnson Lake	3	150
Little Cow Lake	15	200
Lake Dean	90	225
Little Lake	2	175
Middle Lake	6	200
Moon Lake No. 1	3	175
Moon Lake No. 2	8	175
Twin Lakes	16	225
12al(f)-4		
Little Lake	15	280
Trusler Lake	8	230

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Franklin (cont)		
12al(f)-1		
Bayou Macon Cutoff No. 1		238
Bayou Macon Cutoff No. 2		140
Bayou Macon Cutoff No. 3		138
Harris Lake	27	225
Hollywod Lake	40	250
Redfield Lake	5	175
Total	4,117	
La Salle		
12-7 and 12-8		
Saline Lake	1,810	200
12al(g)-2		
Horseshoe Lake	25	200
Hub Lake	14	180
Kitterlin Bay	160	210
Walker Lake	88	200
Lehman Lake	20	200
Round Lake	12	170
Search Lake	20	160
Trout Mill Ponds	95	130
Woodward Lake	7	140
12al(g)-2A		
Catahoula Lake	5,000-25,000	
Little Lake	35	140
Little Lake Slough	10	130
Willow Lake	50	180
12al(g)(1)(a)-1		
Hunts Pond	12	170
12al(g)(1)(a)-2		
Urania Mill Pond	25	170
Total	17,383	
Ouachita [b/]		
Cheniere Brake	3,115	120 [c/]
Cotton Patch Lake	15	190
Country Club Lake	65	160
D'Arbonne Hills Lake	35	320
Hamilton Lake	55	320
Ouachita (cont)		
Horseshoe Lake	40	285
Lake Lafitta	100	410
Little Lake	8	160
McGuire Lake No. 1	6	160
McGuire Lake No. 2	12	160
Mills Pond	20	160
Moon Lake	60	325
Pace Lake	80	380
Phillips Lake	65	240 [c/]
Pucketts Lake	5	160
Rushing Lake	55	275
Walls Lake Basin	50	310
Walls Lake	30	345
Whites Lake	40	320
12al(e)-8		
Black Bayou Lake	2,000	120 [c/]
Bayou DeSiard (north)		608
Bayou DeSiard (south)		607
Kings Lake	80	420
Ramson Lake	50	360
Water Lake	14	140
Total	7,215	
Rapides		
12-10		
Bayou Maria Basin	360	140
Beaver Lake	125	130
Big Lake	30	120
Buttonwood Lake	200	110
Hog Lake	500	120
Lockhart Lake	30	110
Mill Pond	30	120
Pierson	28	130
Spring Bayou	260	160
Tanyard Lake	100	140
Tarkill Lake	70	130
Williams Lake	500	180
Camp Beauregard Lake	23	150
Total	2,256	

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)	Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Richland [b/]			Tensas (cont)		
12al(e)-4A			Levi Lake	35	170
Cutoff Bayou	20	90	Little Fletchers	75	195
Hammett Lake	12	160	Mackey Lake	8	150
Hewitt Lake	30	130	May Lake	20	160
Jonesburg Lake	75	80	Mile Lake	8	140
Jordan Lake	50	120	Miller Lake	20	150
McElroy Lake	30	110	Mossy Lake	18	160
Saryre Lake	14	140	Reed Lake	25	170
Tank Lake	5	90	Saddletree Lake	38	185
Thompson Lake	30	60	Shelley Lake	5	140
Wollen Lake	240	160	Snotgrass Lake	10	150
			Turkey Lake	8	160
12al(e)-10C			Wilson Lake	12	165
Clear Lake	160	170 [c/]			
Crew Lake	70	60	12al(f)-4		
Dead Lake	10	130	Alligator Slough	20	140
Little Lake LaFourche		165	Big Lake	120	195
			Big Pond	75	190
Total	910		Brushy Lake	15	180
			Duck Lake	155	200
Tensas			Fool Lake	60	190
			Grassy Lake	210	200
12al(f)-2			Hopaka Lake	45	190
Allen Lake	10	150	Johnson Lake	85	185
Bell Lake	5	140	Lake Bruin	3,000	220
Big Hog Glade	28	160	Lake Marydale	135	200
Big Lake	70	190	Lake St. Joseph	1,300	220
Black Lake	38	195	Lake Shallow	30	190
Boggy Lake	45	180	Little Flag Lake	22	180
Bowman Lake	5	150	Little Johnson Lake	60	170
Broad Lake	35	170	Lodge Lake	45	165
Brushy Lake No. 1	25	180	Long Lake	12	170
Brushy Lake No. 2	22	180	Mill Lake	390	195
Bryland Lake	75	195	Molen	8	180
Cindy Lake	8	140	Mud Lake No. 1	55	190
Duck Lake	22	160	Mud Lake No. 2	485	195
Fish Lake	5	140	Shackleford Lake	48	180
Fletchers Lake	440	200	Sketter Lake	22	175
Fox Lake	60	180	Turkey Lake	55	180
Gin Lake No. 1	8	160	Watermelon Lake	12	170
Gin Lake No. 2	15	170	Daniel Lake	15	175
Hunter Lake	5	160	Willow Lake	12	170
Jackson Lake	18	150	Lake Twentynine	30	180
Lackmen Lake	18	150	Cow Lake	30	185
Lake Black Dog	8	160	Brushy Lake No. 3	7	180
Lake Formosa	65	170	Brushy Lake No. 4	50	190
Lake Misery	12	170			

TABLE 2 (Cont)

Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)	Parish and Lake	Surface Area (acres)	Estimated Standing Crop (lbs/ac)
Tensas (cont)					
Trosler Lake	8	160			
Little Lake	12	170			
Horse Lake	30	180			
Total	7,982				

Sources: Louisiana Department of Wildlife and Fisheries and Soil Conservation Service.

a/ Watershed number.

b/ Estimate of standing crop for these parishes provided by Louisiana Department of Wildlife and Fisheries.

c/ Actual population sample data.

pecan, willow oak, sweetgum, cypress, water elm, and water locust. Reliable studies have shown that such bottom-land species are benefited by seasonal flooding. Improved tree growth and mast production is, in turn, beneficial to wildlife species, such as deer, squirrel, and waterfowl, that depend to some extent on mast for food supply. The presence of water from seasonal flooding is essential to use of the area by waterfowl, wading birds, and certain furbearers, reptiles and amphibians. Seasonal flooding of the forest areas also makes a positive contribution to the aquatic resources of lakes and streams by providing extensive feeding, spawning, and nursery areas. The flooded forests and wetlands serve as storage areas for floodwaters and recharge areas for groundwater. The wetlands also play an important role in natural filtration, contributing to the maintenance of water quality. Seasonal flooding is necessary for the continued existence of the present bottom-land and wetland ecosystems.

Annually Flooded Openland

15. The annually flooded openland is used almost exclusively for soybean production, due in part to compatibility with frequent flooding. Seasonal flooding of the openlands provides a higher value habitat for game and nongame species when compared to dry openland values. The terrain of the area is a series of low ridges and swales; in many instances, ponded water is found in low areas. These isolated wet areas provide ideal habitat for waterfowl, wading birds, furbearers, and reptiles and amphibians. These isolated wet areas, by preventing intensive farming, allow the occurrence and growth of native grasses, herbs, and woody vegetation. This diversity of habitat is

highly beneficial to small game such as rabbits, quail, and dove and a variety of nongame birds and small mammals. Small mammals provide food sources for hawks, owls, and other predators. Flooding of the low areas, including native vegetation and soybean fields, provides food sources for waterfowl in season. Periodic flooding of openlands is important to maintaining the present habitat conditions for wildlife.

Wildlife Resources

16. Broadly classified wildlife habitat types (vegetative types) include bottomland hardwoods, pasture land, and cropland. Table 3 summarizes the Louisiana population and harvest data for selected game species (rabbit, squirrel, turkey, deer, quail, and dove). This information is presented by parish and habitat type. Population data including habitat acreages, animals per acre, and total animals and harvest data including number harvested and man-days of recreation are presented. The harvest data were calculated from a 3-year average of small game surveys conducted in 1967-1968, 1972-1973, and 1974-1975. Since this survey is broken down by parish and based on the number of hunting licenses sold by parish, the resulting harvest data do not reflect an accurate measure of harvests within each of the individual parishes. Rather, it reflects the estimated harvest by persons who bought licenses in that parish. Of equal importance are various other wildlife species including waterfowl, raptors, passerines, wading birds, furbearers, and amphibians.

TABLE 3

INVENTORY OF GAME SPECIES, POPULATION, AND HARVEST DATA, LOUISIANA[a/]

Species	Parish	Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation	Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation
		UPLAND HARDWOOD					BOTTOM-LAND HARDWOOD				
Rabbit											
	Avoyelles	2,509	1-7	358	36	24	117,913	1-1	117,913	11,791	7,757
	Caldwell	56,052	1-7	8,007	801	527	98,091	1-1	98,091	9,809	6,453
	Catahoula	28,769	1-7	4,110	411	270	119,185	1-1	119,185	11,919	7,841
	Concordia			b/			213,830	1-1	213,830	21,383	14,068
	Franklin			b/			53,070	1-1	53,070	5,307	3,491
	LaSalle	35,423	1-7	5,062	506	333	122,009	1-1	122,009	12,201	8,027
	Ouachita	34,083	1-7	4,869	487	320	104,683	1-1	104,683	10,468	6,887
	Rapides	12,193	1-7	1,742	174	114	40,644	1-1	40,644	4,064	2,674
	Richland						87,020	1-1	87,020	8,702	5,725
	Tensas						137,680	1-1	137,680	13,768	9,058
Squirrel											
	Avoyelles	2,509	1-1.0	2,509	836	442	117,913	1-.75	15,722	5,241	2,773
	Caldwell	56,052	1-1.0	56,052	18,684	9,886	98,091	1-.75	130,788	43,596	23,067
	Catahoula	28,769	1-1.0	28,769	9,590	5,074	119,185	1-.75	158,913	52,971	52,969
	Concordia			b/			213,830	1-.75	285,107	95,036	50,284
	Franklin			b/			53,070	1-.75	70,760	23,587	12,480
	LaSalle	35,423	1-1.0	35,423	11,808	6,248	122,009	1-.75	162,679	54,226	28,691
	Ouachita	34,083	1-1.0	34,083	11,361	6,011	104,683	1-.75	139,577	46,526	24,617
	Rapides	12,193	1-1.0	12,193	4,064	2,150	40,644	1-.75	54,192	18,064	9,558
	Richland						87,020	1-.75	116,027	38,676	20,463
	Tensas						137,680	1-.75	183,573	61,191	32,376

TABLE 3 (cont)

Species	Parish	Population Data			Harvest Data		Population Data			Harvest Data	
		Habitat Acres	Animals Per Acre	Total Animals	Number	Man-days Recreation	Habitat Acres	Animals Per Acre	Total Animals	Number	Man-days Recreation
Turkey											
	Avoyelles										
	Caldwell	56,052	1-500	122		No season	98,091	1-1,300	75		No season
	Catahoula	28,769	1-1,000	288		No season	119,185	0	0	0	0
	Concordia			b/			213,830	1-10,000	21		No season
	Franklin			b/			53,070	1-1,000	53	5	300
	LaSalle	35,423	1-2,000	18		No season	122,009	1-1,000	122		No season
	Ouachita	34,083	1-500	68	2	120	104,683	1-2,000	52	3	180
	Rapides			b/							
	Richland			b/			87,020	1-500	17		No season
	Tensas			b/			137,680	1-250	551	20	1,200
Deer											
	Avoyelles	2,509	1-25	100	12	275	117,913	1-20	5,896	545	12,481
	Caldwell	56,052	1-25	2,242	423	9,687	98,091	1-20	4,905	739	16,923
	Catahoula	28,769	1-25	1,151	93	2,130	119,185	1-20	5,959	386	8,839
	Concordia			b/			213,830	1-20	10,692	5,178	118,567
	Franklin			b/			53,070	1-20	2,654	311	7,122
	LaSalle	35,423	1-25	1,417	79	1,809	122,009	1-30	4,067	272	6,229
	Ouachita	34,083	1-25	1,363	162	3,710	104,683	1-25	4,187	496	11,358
	Rapides	12,193	1-25	489	15	344	40,644	1-25	1,626	49	1,122
	Richland						87,020	1-20	4,351	602	13,786
	Tensas						137,680	1-7	19,669	5,679	130,049

TABLE 3 (cont)

Species	Parish	Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation	Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation
		PURE PINE					MIXED PINE - HARDWOOD				
Squirrel											
	Avoyelles	5,108	1-9	558	186	98					
	Caldwell	70,065	1-9	7,785	2,595	1,373	56,052	1-2.5	22,421	7,474	3,955
	Catahoula	14,384	1-9	1,598	533	282	43,152	1-2.5	17,261	5,754	3,044
	Concordia			b/							
	Franklin	5,825	1-9	647	216	114	5,825	1-2.5	2,330	777	411
	LaSalle	181,047	1-9	20,116	6,705	3,548	55,101	1-2.5	22,040	7,347	3,887
	Ouachita	70,601	1-9	7,845	2,615	1,384	34,083	1-2.5	13,633	4,544	2,404
	Rapides	58,256	1-9	6,473	2,158	1,142	24,387	1-2.5	9,755	3,252	1,721
	Richland			b/							
	Tensas			b/							
Quail											
	Avoyelles	5,018	1-3	1,673	167	77					
	Caldwell	126,117	1-3	42,039	4,204	1,937					
	Catahoula	57,536	1-3	19,179	1,918	884					
	Concordia			b/					NOT APPLICABLE		
	Franklin	11,650	1-3	3,883	338	179					
	LaSalle	236,148	1-3	78,716	7,872	3,628					
	Ouachita	104,684	1-3	34,895	3,490	1,608					
	Rapides	82,643	1-3	27,548	2,755	1,270					
	Richland										
	Tensas										

TABLE 3 (cont)

Species	Parish	PASTURELAND Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation	CROPLAND Population Data: Habitat Acres	Population Data: Animals Per Acre	Population Data: Total Animals	Harvest Data: Number	Harvest Data: Man-days Recreation
Dove											
	Avoyelles	18,600	1-.8	23,250	3,488	872	83,120	1-.8	103,900	15,585	3,896
	Caldwell	18,670	1-.8	23,338	3,501	875	36,920	1-.8	46,150	6,923	1,731
	Catahoula	8,880	1-.8	11,100	1,665	416	239,270	1-.8	299,088	44,863	11,216
	Concordia	49,230	1-.8	61,538	9,231	2,303	122,200	1-.8	152,750	22,913	5,728
	Franklin	59,000	1-.8	73,750	11,063	2,766	255,220	1-.8	319,025	47,854	11,964
	LaSalle	6,230	1-.8	7,788	1,168	292	5,450	1-.8	6,813	1,022	256
	Ouachita	25,170	1-.8	31,463	4,719	1,180	64,240	1-.8	80,300	12,045	3,011
	Rapides	5,400	1-.8	6,750	1,013	253	1,680	1-.8	2,100	315	79
	Richland	73,970	1-.8	92,463	13,869	3,467	192,370	1-.8	240,463	36,069	9,017
	Tensas	75,550	1-.8	94,438	14,166	3,542	114,790	1-.8	143,488	21,523	5,381
Quail											
	Avoyelles	18,600	1-3	6,200	620	286	83,120	1-3	27,707	2,771	1,277
	Caldwell	18,670	1-3	6,223	622	287	36,920	1-3	12,307	1,231	567
	Catahoula	8,800	1-3	2,933	293	135	239,270	1-3	79,757	7,976	3,676
	Concordia	49,230	1-3	16,410	1,641	756	122,200	1-3	40,733	4,073	1,877
	Franklin	59,000	1-3	19,667	1,967	906	255,220	1-3	85,073	8,507	3,920
	LaSalle	6,230	1-3	2,077	208	96	5,450	1-3	1,817	182	84
	Ouachita	25,170	1-3	8,390	839	387	64,240	1-3	21,413	2,141	987
	Rapides	5,400	1-3	1,800	180	83	1,680	1-3	560	56	26
	Richland	73,970	1-3	24,657	2,466	1,136	192,370	1-3	64,123	6,412	2,955
	Tensas	75,550	1-3	25,183	2,518	1,160	114,790	1-3	38,263	3,826	1,763

TABLE 3 (cont)

		Population Data			Harvest Data		Population Data			Harvest Data	
Species	Parish	Habitat Acres	Animals Per Acre	Total Animals	Number	Man-days Recreation	Habitat Acres	Animals Per Acre	Total Animals	Number	Man-days Recreation
Rabbit											
	Avoyelles	18,600	1-1	18,600	1,860	1,224	83,120	1-15	5,541	554	364
	Caldwell	18,670	1-1	18,670	1,867	1,228	36,920	1-15	2,461	246	162
	Catahoula	8,800	1-1	8,800	880	579	239,270	1-15	15,951	1,595	1,049
	Concordia	49,230	1-1	49,230	4,923	3,239	122,200	1-15	81,347	8,135	5,352
	Franklin	59,000	1-1	59,000	5,900	3,882	255,220	1-15	17,015	1,702	1,120
	LaSalle	6,230	1-1	6,230	623	410	5,450	1-15	363	36	24
	Ouachita	25,170	1-1	25,170	2,517	1,656	64,240	1-15	4,283	428	282
	Rapides	5,400	1-1	5,400	540	355	1,680	1-15	112	11	7
	Richland	73,970	1-1	73,970	7,397	4,866	192,370	1-15	12,825	1,283	844
	Tensas	75,550	1-1	75,550	7,555	4,970	114,790	1-15	7,653	765	503

a/ Source: Louisiana Department of Wildlife and Fisheries and Soil Conservation Service.

b/ Data unavailable.

17. As previously mentioned, the Catahoula Lake complex is extremely important for waterfowl in the Mississippi Flyway. It plays an important role in the abundance and distribution of waterfowl. The Louisiana Department of Wildlife and Fisheries' biologists estimated that this one lake had a yearly average of 20,369,000 "duck days" for the 10-year period 1960-1970. It is estimated that 80,000 ducks were harvested on Catahoula Lake during the 1970-71 hunting season.

18. Attachment 2 presents data that were developed for the Sicily Island and the Below Red River areas (parts of the Red River Backwater Area) and will be used for actual evaluation purposes in the Environmental Effects section.

Endangered Species

19. A study of the endangered species in the Below Red River Area was conducted by Louisiana State University in May 1977 for the Vicksburg District to determine the present status of seven endangered animal species which could possibly occur in the area. The study concluded that the American alligator was the only endangered species (now classified as threatened in Louisiana) that occurred in the area. The bald eagle and peregrine falcon may occasionally occur in migration. There is no possibility that the red wolf and ivory-billed woodpecker survive in the area and little, if any, possibility of the Bachman's warbler being present. Little habitat for the Florida panther remains in the project study area and no evidence of occurrence was found during the study. In studies conducted for Bushley Bayou, Sicily Island, and the Tensas River, similar conclusions were drawn.

Federal Wildlife Refuges and State Wildlife Management Areas

20. Within the Red River Backwater study area, there are six wildlife management areas, one state waterfowl refuge, and one national wildlife refuge. Table 4 gives the location, size, and administrative agency of these areas as of June 1979.

TABLE 4
INVENTORY OF FEDERAL REFUGES AND STATE WILDLIFE MANAGEMENT AREAS
JUNE 1979

Wildlife Area or Refuge	Parish	Size (acre)	Administrative Agency[a/]
Wildlife Management Areas			
Grassy Lake	Avoyelles	11,860	LDWF
Pomme DeTerre	Avoyelles	3,991	LDWF
Red River	Concordia	16,604	LDWF
Saline	LaSalle and Concordia	60,275	LDWF
Spring Bayou	Avoyelles	11,677	LDWF
Three Rivers	Concordia	23,231	LDWF
State Waterfowl Refuge			
Catahoula	LaSalle	1,010	LDWF
National Wildlife Refuge			
Catahoula	LaSalle	5,308	FWS

a/ LDWF - Louisiana Department of Wildlife and Fisheries
FWS - U. S. Fish and Wildlife Service

Unique, Natural and Scenic Streams

21. Under Louisiana's Natural and Scenic Rivers System Act (R.S. 56: 1841-1849), a number of streams and stream segments have been identified as natural and scenic rivers. Four of these are located in or near the Red River Backwater Area. These include:

a. Little River from the juncture of Dugdemona and Castor Creeks to its entrance into Catahoula Lake.

b. Trout Creek from its origin near Highway 8 to its entrance into Little River.

c. Saline Bayou from Saline Lake to Larto Lake.

d. Bayou Cocodrie from Wild Cow Bayou to Little Cross Bayou in Concordia Parish.

Prime or Unique
Farmland

22. Due to the frequency of flooding in the directly affected portion of the Red River Backwater Area, most areas would not meet the criteria of the U. S. Department of Agriculture which state: The soils are not flooded frequently during the growing season (less often than once in 2 years) and will not be addressed in this evaluation.

Cultural or Historical Resources

23. A number of cultural studies have been conducted under Corps contract within the general area. A summary of these studies and a comprehensive bibliography are contained in Attachment 1 and will not be reiterated in this section of the report.

ENVIRONMENTAL EFFECTS

GENERAL

24. Even minor modifications of hydrologic regime within a dynamic river system can result in direct and cumulative environmental effects in the immediate area and both upstream and downstream. Hydrologic and economic data developed in the course of this study indicated that modification of the existing 70/30 split (used as a base condition) during the months May, June, and July will directly affect approximately 3,000 acres of cleared land and 8,600 acres of woodland within the backwater area on an average annual basis. Land use projections indicate that in anticipation of possible modification, 601 and 369 acres of bottom-land hardwoods would be cleared in the Sicily Island and the Below Red River areas, respectively. Man-day values per acre for various wildlife forms by habitat type are presented in Table 5. These data are averages of data developed in the Sicily Island and Below Red River areas presented in Attachment 2. In addition to the quantifiable impacts, this environmental evaluation will briefly address qualitatively the geo-hydro-biological interrelationships of the area's rivers and their flood plains. The entire length of a river system should be considered in evaluating the function of any part. Hydrological phenomena are extremely important within the systems. The ecosystems of

the backwater area, as with most alluvial systems, are adapted and dependent upon fluctuating water levels. The importance of the wooded flood plain and wetland areas to water quality will not be reiterated in detail. A number of documented studies have shown the importance of the contact time between water and organic debris and the removal of various pollutants.

TABLE 5
MAN-DAY VALUE PER ACRE a/
BY HABITAT TYPE

Habitat Type	Bottom-Land Hardwood	Openland
Large game	0.368	0.0
Small game	0.45	0.128
Waterfowl	0.109	0.019
Wildlife-oriented recreation	0.81	0.13
Fur Harvest	(0.17)	(0.044)
Total Man-Day Value Per Acre	1.737	0.277

a/ Average of data presented in Attachment 2.

OPEN WATER AND WETLANDS

25. Decreasing the diversion of water from the Mississippi River during the late spring and early summer months would result in detrimental effects to open water and associated wetland areas unless there would be a corresponding increase of flows during critical low-water periods. Stabilized water levels

aquatic and terrestrial species within the immediate area and downstream. Quantifying these types of environmental effects is difficult and requires time and effort for a detailed study. However, some effects can be quantified. Hydrologic and economic studies can project induced clearing rates in anticipation of reduced flooding within the area. In addition to the Vicksburg District studies that have been conducted, other studies have shown that there is a direct correlation between reduced flooding during the planting season and the rate of clearing bottom-land hardwoods in the Alluvial Valley. It appears that forested areas adjacent to agricultural land, if dewatered during the planting season, are generally the areas to be affected. Our immediate studies have shown that there will be induced clearing in anticipation of reduced flooding and stabilized flooding stages within the backwater area. Our study has shown that 970 acres of forested land would be cleared and converted to agricultural uses within the Red River Backwater Area.

ANNUALLY FLOODED OPENLAND

28. Modification of flows in May, June, and July during the planting season would reduce flooding on 2,862 acres of cleared land. In anticipation of stabilized flood stages, 970 acres of forested area would be cleared and converted to agricultural land. Reduced flooding would be beneficial from an agricultural and economic standpoint. However, it would result in adverse impacts on the environmental resources.

during the planting season would induce further land clearing and diminish the mineral rejuvenation realized from backwater sedimentation. Encroachment by agriculture will increase the sediment and the associated agriculture pollutant levels in the remaining open water and wetlands that are currently experiencing some environmental stress. Increased sediment loads in lakes will, in time, increase lake bottom elevations, decreasing water depths which in turn will decrease the area's permanent water bodies. Succession of wetlands to drier habitat types could be accelerated.

FISHERY RESOURCES

26. Decreased water depths in open water areas would reduce the intra-habitat diversity within those areas. Loss of any open water area that provides the only available habitat for aquatic species during the critical summer and fall low-water periods would result in declines in density, standing crop, and year class strength of numerous aquatic species. Drying of wetland areas during late spring and early summer would reduce the amount of essential spawning, feeding, and nursery areas which in turn would increase competition for mutual life requisites.

ANNUALLY FLOODED FORESTS

27. The trophic system of annually flooded forests is dependent upon the annual sequence of high- and low-water periods. Altering of the system would directly affect biological productivity. Decreases in the amount of available detritus on the forest floor would affect the related food chains of various

WILDLIFE RESOURCES

29. Wildlife resources in the Red River Backwater Area would be both benefitted and adversely affected if flows are modified during May, June, and July. Loss of bottom-land hardwood habitat when compared to an increase of openland habitat would result in a direct net loss of 1,416 man-days of wildlife-oriented use. Benefits of 269 man-days associated with an increase in openland habitat are greatly overshadowed by the direct loss of 1,685 man-days which are associated with a decrease in bottom-land hardwood habitat, resulting from the induced clearing of 970 acres of such habitat.

ENDANGERED SPECIES

30. No longer classified as endangered but still classified as threatened, the American alligator is a permanent resident in the backwater area. No endangered species are permanent residents of the backwater area, so there should be no adverse effects to any species classified as endangered.

FEDERAL WILDLIFE REFUGES AND STATE WILDLIFE MANAGEMENT AREAS

31. The refuges and management areas are protected by law from induced land use changes but could experience some increased pressure and stress problems if privately owned lands, both wooded and wetlands, surrounding these protected areas are cleared or modified.

SCENIC STREAMS

32. Modification of flows through the Old River Control would not appreciably impact the scenic streams within the Red River Backwater Area.

CULTURAL RESOURCES

33. Effects on cultural resources of the Red River Backwater Area are discussed in Attachment 2.

CONCLUSIONS

34. Based on stage-frequency data for the years of 1949-1974, stages at the Acme gage do not exceed 45 feet, NGVD, every year during the months of May, June, and July. Even considering that this is not an annual event, economic studies have shown that induced clearing would take place in anticipation of stabilized flood elevations.

35. Within recent years the land clearing trend in the backwater area has accelerated and it appears that the trend is following that of the north Louisiana parishes. This trend strongly indicates that the future for privately owned forested wetlands in the Red River Backwater Area does not appear to be good, unless acquisition for preservation increases or applicable regulatory programs are effective. Any further inducement will only

accelerate the trend, and this study has shown that modification of flows through the Old River Control Structure during the planting season would further induce the clearing of an additional 970 acres.

36. If the authorized 70/30 annual distribution is to be maintained and flows are decreased during every spring and summer, then flows must be increased at some point during the year. If this is feasible (i.e., water is available), adverse impacts could possibly be offset by benefiting fish and wildlife resources during critical low water stress periods. However, if corresponding increases are not feasible, the authorized 70/30 distribution would not be maintained, resulting in a net adverse impact to fish and wildlife resources in the backwater area and further downstream. However, the losses associated with induced land clearing cannot be compensated without appropriate mitigation measures.

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ATTACHMENT 1
POSSIBLE IMPACTS ON
CULTURAL RESOURCES WITH MODIFIED OPERATION OF THE
OLD RIVER CONTROL STRUCTURE

1. Inclosure 1 is an annotated bibliography of cultural resources investigations conducted in the Red River Backwater Area by the Vicksburg District. Should the modified plan (holding stages at Acme, Louisiana, at elevation 45.0 feet, NGVD, when possible during the months of May, June and July) be implemented, comprehensive reconnaissance and intensive on-ground surveys will be necessary for those lands which will be affected by Corps activities.

2. If the modified plan is implemented and additional agricultural lands are made available through land clearing, any existing cultural resources on these lands could be adversely impacted. Increased land clearing and leveling operations, as well as plowing activities, may destroy or at least have a negative effect on archeological/historic sites. Exposure of any sites through these activities may lead to vandalism as a result of their visibility. In addition, other construction activities made possible because of lowered water levels (such as ditching and leveeing) could adversely affect cultural resources.

3. Although the effects of intermittent inundation on cultural resources or newly cleared lands have not been intensively studied, impacts may include:

a. Chemical alteration of soil, shell, bone, and charcoal causing incorrect interpretations of these remains.

b. Wave action, saturation, and erosion causing sites to lose all associative contextural properties and thus lose their value as resources for scientific investigation.

c. Physical loss of sites through erosion.

CULTURAL RESOURCES INVESTIGATIONS
OF RED RIVER BACKWATER AREA PERFORMED FOR VXD

Brazda, Steven J.
1976 Archeological Survey of the 1975 Catahoula Lake Diversion Channel Dredging Project, LaSalle Parish, Louisiana

Comment: No archeological sites observed or recovered during the dredging activities on the diversion channel.

Coastal Environments, Inc.
1981 A Cultural Resources Survey of the Tensas-Cocodrie Levee Enlargement, Item 2, Concordia Parish, Louisiana

Comment: 15 sites noted in survey (1 prehistoric occupation, 12 historic sites, 2 prehistoric/historic sites.

Gibson, Jon
1981 (In preparation) Cultural Resources Survey of the Sicily Island Area Levee Project, Item 1

Comment: Seven archeological sites located in rights-of-way; one site of National Register significance.

Gregory, H. F. and H. K. Curry
1976 Archeological Reconnaissance, Lower Bushley Bayou Project

Comment: Three sites located in project area but none was significant. Reconnaissance included on-the-ground survey, records check, and literature search.

Gulf South Research Institute
1974 History and Archeology of the Red River Backwater General/Sicily Island/Bushley Bayou Area, Louisiana

Comments: The report was found to be acceptable as a general archeological reconnaissance, but lacked sufficient information for evaluation of properties which may be eligible for inclusion in the National Register of Historic Places. A literature search was conducted for the Red River Backwater portion of the project, but this was not done for the Sicily Island and Bushley Bayou Areas. A total of 75 sites were previously recorded in the Red River Backwater Area prior to the GSRI study. An on-the-ground survey was conducted in the Sicily Island and Bushley Bayou areas. Sixty-one prehistoric and 14 historic sites were recorded in the Sicily Island area (1,000-foot corridor, 500 feet either side of the proposed levee alignments). The on-the-ground survey along Bushley Bayou revealed 15 prehistoric and 5 historic sites.

Gulf South Research Institute
1975 Bayou Cocodrie Archeological Survey

Comments: One significant site (16CO50) was located, but once discovered, the site area was eliminated from survey area. Study area extended along Bayou Cocodrie from the proposed floodgate to the proposed cutoff.

Marshall, Richard A.
1977 Cultural Resource Survey of Tensas-Cocodrie Item 3-B and 1, Concordia Parish, Louisiana

Comment: Survey located an area of possible Civil War action in the west end of Grand Cutoff Bayou and cemetery positioned on an Indian mound.

Neitzel, Robert S.
1976 Archeological Survey Report, Proposed Levee Alignments of Red River Backwater Area, Lower Red River

Comment: Two major mound/village/plaza sites in the project vicinity of Levee No. 1, but were not within the rights-of-way. Levee No. 2 intrudes into two major sites near the Spring Bayou end. Three smaller sites were adjacent to the proposed alignment.

Neitzel, Robert S.
1976 Archeological Survey of Items 4 and 5 of Catahoula Lake to Jonesville Levee

Comment: Rights-of-way along French Fork and Little River were examined. Nine sites were located.

Neitzel, Robert S.
1976 Archeological Reconnaissance of Item 3-A Tensas-Cocodrie Levee Enlargement, Mile 24 to Mile 27 on Red River

Comment: No cultural resources were located.

Neitzel, Robert S.
1978 Archeological Survey - Item 5, Acme to Blackhawk Levee Enlargement, Lower Black and Red Rivers

Comment: Although no cultural resources were located in the project rights-of-way, several sites were noted in the general vicinity.

Neitzel, Robert S.
1978 Cultural Resource Impact Statement, Archeological Survey, Six Mile Bayou Project, Acme, Louisiana, Lower Black River, Concordia Parish

Comments: No significant cultural resources located in the project area (2-mile course encompassing 0.5-mile-wide strip.

Servello, A. Frank
1976 Archeological Survey of the Louisiana-Mississippi River Levee Between Morville and Blackhawk, Louisiana

Comment: Four historic (late 19th C.) archeological sites located within survey area.

ATTACHMENT 2
TERRESTRIAL HABITAT EVALUATION
(Revised 1981)

1. The following is a brief description of the various terrestrial habitats in the project areas:

The project area is comprised of several habitat types including bottom-land forests, wetlands, idle lands, soybean fields, cornfields, cottonfields, and pasturelands. The woodlands are primarily on Sharkey Association flooded soils and include overcup oak-bitter pecan, oak-gum-cypress, redgum-mixed hardwoods, and oak-mixed hardwood associations. These woodlands provide generally good wildlife habitat for a variety of wildlife species. These woodland associations have fair to very good mast bearing trees and understory diversity and cover. Ground cover was sparse to good depending upon location and was fairly diverse. Tree size ranged considerably and all woodlands are seasonally flooded. The agricultural lands are essentially monocultures and the average field size is about 360 acres. These fields are poor to good wildlife habitat for a variety of species. The fields are seasonally flooded and occur on Sharkey Association flooded, Sharkey Association, and Calhoun-Calloway Association soils.

2. Computations for man-day use factors for all bottom-land hardwoods:

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/70	1/280	22.9	.08
Deer	1/20	1/60	15.6	.26
			Total =	.34
			Use	.34

b. (1) Small game (dry).

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1.6	1/4.8	.56	.32
Quail	1/18	1/28	.59	.02
Squirrel	1/2	1/6	.67	.11
Raccoon	1/12	1/48	.76	.016
Opossum	1/1.5	1/6	.70	.12
			Total =	.586
			Use	.59

(2) Small game (seasonally flooded)

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2	1/6	1.56	0.26
Quail	1/22	1/37	0.59	0.016
Squirrel	1/2	1/6	0.67	0.11
Raccoon	1/10	1/40	0.76	0.019
Opossum	1/1.25	1/5	0.70	0.14
			Total =	0.545
			Use	0.54

c. Waterfowl (when flooded).

Population/acre[a/]	Harvest/acre	Effort for One	Man-day/acre/year
2.5/1	1/2	.38	.19
		Use	.20

a/ Includes wetlands.

d. Wildlife-oriented recreation (estimated).

1.0 man-day/acre/year (flooded)
.83 man-day/acre/year (dry)

3. Computations for man-day use factors for wetlands.

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/111	1/444	22.9	.05
Deer	1/33	1/99	15.6	.16
			Total =	.21
			Use	.21

b. Small game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/4	1/12	1.56	.13
Quail	1/30	1/60	0.59	.01
Squirrel	1/6	1/13	0.67	.05
Raccoon	1/20	1/76	0.76	.01
Opossum	1/4	1/14	0.70	.05
			Total =	.25
			Use	.25

c. Wildlife-oriented recreation (estimated).

1.00 man-day/acre/year (flooded)
.83 man-day/acre/year (dry)

4. Computations for man-day use factors for agricultural lands (based on average farm size of 360 acres).

a. "Edge" of cottonfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2.5	1.8	1.56	.208
Dove	1/2.5	1/5	0.14	.026
Quail	1/1.6	1/3	0.59	.184
Fox	1/200	1/100	9.80	.098
Raccoon	1/11	1/25	0.76	.030
Opossum	1/1.25	1/5	0.70	.140
			Total =	.686
			Use	.69

Note: "Edge" of 1 field = 1.7 acres.
A 360-acre cottonfield will provide 1.2 total man-days use.

b. "Idle" lands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/2.5	1/8	1.56	.20
Dove	1/2.5	1/5	0.14	.03
Quail	1/1.6	1/3	0.59	.18
Fox	1/200	0	0	0
Raccoon	1/11	1/50	0.76	.02
Opossum	1/1.4	1/6	0.70	.12
			Total =	.55
			Use	.55

One average 360-acre "idle" field will provide 198 man-days use.

c. Pasturelands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/10	1/33	1.56	.047
Dove	1/10	1/33	0.14	.004
Quail	1/7	1/14	0.59	.041
Fox	1/1,000	0	9.80	0
Raccoon	1/50	0	0.76	0
Opossum	1/5	1/20	0.70	.035
			Total =	.127
			Use	.13

d. Soybean and cornfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/3.3	1/10	1.56	.16
Dove	1/17	1/33	0.14	.004
Quail	1/8	1/17	0.59	.035
Fox	0	0	0	0
Raccoon	0	0	0	0
Opossum	0	0	0	0
			Total =	.19
			Use	.19

5. Computation of man-day use factors that can be applied to all agricultural lands in the Sicily Island project area.

Item	Number of Fields	Total Man-days
Cotton	10	12
"Idle" lands	6	1,188
Pasturelands	14	658
Soybeans and corn	121	8,954
	Total =	10,812

10,812 ÷ 54,770 acres = .19 man-days/acre

6. Waterfowl usage on flooded soybean fields.

Population/acre	Harvest/acre	Effort for One	Man-day/acre/year
2.5/1	1/2	.38	.19
		Use	.20

7. Small game man-day use factors that can be applied to all flooded agricultural lands in the Sicily Island project area.

a. "Edge" of cottonfields same 360 acres = 1.2 man-days.

b. "Idle" lands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1.4	1/4	1.56	.38
Dove	1/2.5	1/5	0.14	.02
Quail	1/1.1	1/2	0.59	.27
Fox	1/200	0	9.80	0
Raccoon	1/11	1/50	0.76	.02
Opossum	1/1.4	1/6	0.70	.12
			Total =	.81
			Use	.81

c. Pasturelands.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/8	1/25	1.56	.062
Dove	1/10	1/33	0.14	.004
Quail	1/5	1/10	0.59	.060
Fox	1/1,000	0	9.80	0
Raccoon	1/50	0	0.76	0
Opossum	1/5	1/20	0.70	.035
			Total =	.161
			Use	.16

d. Soybean and cornfields.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/4	1/11	1.56	.140
Dove	1/17	1/33	0.14	.004
Quail	1/3	1/6	0.59	.099
Fox	0	0	9.80	0
Raccoon	1/50	1/200	0.76	.010
Opossum	1/25	1/100	0.70	.010
			Total =	.263
			Use	.26

8. Small game man-day use factors that can be applied to all flooded agricultural lands in the Sicily Island project area.

Item	Number of Fields	Total Man-days
Cotton	10	12
Idle lands	6	292
Pasture	14	806
Soybeans and corn	121	10,648
		11,758

11,758 ÷ 54,700 acres = .21 man-days/acre/year

9. Wildlife-oriented recreation.

.12 (wet)
.10 (dry)

10. Computations to determine per acre values of furbearers.

a. Light woods.

(1) Seasonally flooded.

Species	Population/ acre	Harvest/ acre	Value/ Pelt ($)	Value/acre ($)
Raccoon	1/17	1/67	22.00	0.32
Spotted skunk	1/200	1/300	3.00	0.01
Striped skunk	1/8	1/33	3.00	0.09
Gray fox	1/250	1/1,000	55.00	0.06
Red fox	1/333	1/250	55.00	0.04
Opossum	1/1.5	1/6	5.00	0.83
Bobcat	1/500	1/2,000	70.00	0.04
			Total	1.39
			Use	$1.40/acre

(2) Dry woods.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/25	1/100	22.00	0.22
Spotted skunk	1/250	1/1,000	3.00	0.01
Striped skunk	1/12	1/50	3.00	0.06
Gray fox	1/250	1/1,000	55.00	0.06
Red fox	1/333	1/250	55.00	0.04
Opossum	1/2	1/8	5.00	0.62
Bobcat	1/665	1/2,660	70.00	0.03
			Total	= 1.04
			Use	$1.05

b. Wetlands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Beaver	1/12	1/50	11.00	0.22
Muskrat	1/6	1/23	3.00	0.13
Nutria	1/6	1/23	3.00	0.13
Mink	1/33	1/133	20.00	0.15
Raccoon	1/12	1/50	22.00	0.44
Spotted skunk	1/77	1/300	3.00	0.01
Opossum	1/25	1/10	5.00	0.52
Bobcat	1/1,000	1/3,500	70.00	0.02
Red fox	1/1,000	1/2,750	55.00	0.02
			Total =	1.64
			Use	$1.60

c. Agricultural lands.

(1) Flooded lands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/50	1/200	22.00	0.11
Spotted skunk	1/83	1/333	3.00	0.01
Striped skunk	1/12	1/50	3.00	0.06
Gray fox	1/1,250	1/5,000	55.00	0.01
Red fox	1/500	1/2,000	55.00	0.03
Opossum	1/500	1/2,000	5.00	0.01
Bobcat	1/1,500	1/6,000	70.00	0.01
			Total =	0.24
			Use	$0.25

(2) Dry lands.

Species	Population/ acre	Harvest/ acre	Value Pelt ($)	Value/acre ($)
Raccoon	1/83	1/333	22.00	0.07
Spotted skunk	1/250	1/1,000	3.00	0.01
Striped skunk	1/25	1/100	3.00	0.03
Gray fox	1/2,500	1/10,000	55.00	0.01
Red fox	1/500	1/2,000	55.00	0.03
Opossum	1/625	1/2,500	5.00	0.00
Bobcat	1/1,230	1/4,920	70.00	0.01
			Total	0.16
			Use	0.16

11. Computations to determine man-day use factors under management conditions.

a. Big game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Turkey	1/52	1/208	22.9	.11
Deer	1/15	1/45	15.6	.35
			Total =	.46
			Use	.46

b. Small game.

Species	Population/ acre	Harvest/ acre	Effort for One	Man-day/acre/ year
Rabbit	1/1	1/3	1.56	.52
Quail	1/15	1/33	0.59	.02
Squirrel	1/1.5	1/4	0.67	.17
Raccoon	1/8	1/32	0.76	0.02
Opossum	1/1	1/4	0.70	.18
			Total =	.91
			Use	.91

MAN-DAY DERIVATIONS BY HABITAT TYPE
BELOW RED RIVER AREA, LOUISIANA

Habitat Type	Population Density (Individuals/Acre)	Sustained Annual Harvest Rate (%)	Harvestable Population (Individuals/Acre)	Hunter Success Rate (Man-Day/Individual	Man-Day Value (Man-Day/Acre)
Bottom-Land Hardwoods					
Big Game	0.05	33	0.0165	24.0	0.396
Squirrels	1.30	60	0.78	0.55	0.429
Rabbits	0.5	60	0.3	0.13	0.039
Raccoon	0.01	45	0.0045	0.96	0.004
Waterfowl	0.10	25	0.025	0.67	0.017
Wildlife-Oriented Recreation	0.6	0	0.0	0.0	0.6
Fur Harvest (Pelts)					(0.17)
Total Man-Day Value/Acre					1.485
Other Wetlands					
Big Game	0.001	33	0.003	24.0	0.008
Squirrels	0.0	0	0.0	0.0	0.0
Rabbits	0.0	0	0.0	0.0	0.0
Raccoon	0.012	45	0.005	0.96	0.005
Waterfowl	4.52	25	1.13	0.67	0.76
Wildlife-Oriented Recreation	0.5	0	0.0	0.0	0.5
Fur Harvest (Pelts)					(0.25)
Total Man-Day Value/Acre					1.273

ATTACHMENT 3
Economic Analysis

Atchafalaya Basin Study

1. Introduction. Information herein pertains to the economic evaluation of altering the operation of the Old River Control Structure (ORCS) for flood control purposes in the Red River Backwater Area. The evaluation was based on the period of economic analysis (1991-2090), the period beginning with the estimated date for modified project operation and continuing through the economic project life. As set forth in EC 1105-2-12, flood damages were determined for with and without modified operation procedures. The periods evaluated include 1978 (present, the year in which this analysis was completed), 1991 (base year, the year that the project becomes operational), and two additional incremental periods, 2020 and 2040.

2. Evaluation Procedure. The flood damage evaluation was accomplished by frequency analysis using previously collected survey data, recorded stages and durations of flooding, hydrologic data, and applicable flood analysis curves. Flood analysis curves were prepared for the areas studied to provide an accurate means of converting various types of damage to an average annual basis. These curves depict the relationship between stage and area inundated, stage and frequency of occurrence, area inundated and frequency of occurrence, crop damage and season of the year, stage and damage, and damage and frequency of occurrence.

3. Data Sources. Major input to the evaluation of damages and benefits was obtained from recent and ongoing studies. The total area studied consists of twelve individual areas, eight of which are currently involved in various stages of analysis for specific improvements. The remaining four are involved in comprehensive studies of more general nature, but include extensive data collection. Data analysis reveals that major flood damages are sustained by agricultural properties including crops and noncrop items such as drainage systems, roads, fences, etc. Roads and bridges also incur substantial losses as do structural properties such as residences, commercial and industrial properties, and similar improvements. Additional information on data source and usage is presented throughout this analysis.

4. Base Conditions and Alternatives. Six alternatives have been evaluated and are referred to herein as Alternatives 35, 40, 45, 35 no head, 65-35, and 60-40. Future as well as present hydrologic conditions are included in the analysis. Thus, the base condition (without-project modification) as well as the effect of each alternative vary over time. Total benefits for Alternative 35, for example, consist of present level benefits (representing the effect of Alternative 35 under present hydrologic conditions upon the present base) plus discounted future benefits (representing the effect of Alternative 35 under future hydrologic conditions upon the future base). A major element in the analysis was

that authorized projects, including Bushley Bayou, Sicily Island, and Below Red River, were not considered in operation. Additional description of the base conditions and alternatives included in this analysis is as follows:

a. Base Conditions.

(1) Present Base. Gate control of the ORCS is operated to maintain a 70/30 percentage distribution of total latitude flows between the Mississippi River and the Atchafalaya River. The hydraulic head on the structure must be equal to or less than 20 feet, and the flow past the Morganza Floodway must not exceed 1.5 million cubic feet per second.

(2) Future Base. The ORCS is operated as with the present base using Simmesport and Red River landing rating curves furnished by NOD to simulate future channel conditions.

b. Alternatives.

(1) Alternative 35 (Present and Future). For Alternative 35 Present, the ORCS is operated to maintain Acme stages at or below 35 feet, mean sea level, when possible, while not exceeding head or flow limitations. For Alternative 35 Future, the ORCS is operated to keep Acme at or below 35 feet, mean sea level, when possible, using future channel conditions.

(2) Alternative 40 (Present and Future). Alternative 40 is similar to 35, except stages at Acme are maintained at or below 40 feet, mean sea level, when possible, within head and flow limits.

(3) Alternative 45 (Present and Future). Alternative 45 is similar to 35, except stages at Acme are maintained at or below 45 feet, mean sea level, when possible, within head and flow limits.

(4) Alternative 35 No Head (Present and Future). The ORCS is operated to keep stages at Acme at or below 35 feet, mean sea level, when possible, based on flow constraints only.

(5) Alternative 65-35 (Present and Future). ORCS is operated to maintain a 65-35 percent distribution of total latitude flows between the Mississippi and Atchafalaya Rivers. Head and flow constraints remain the same as with base conditions.

(6) Alternative 60-40 (Present and Future). ORCS is operated to maintain a 60-40 percent distribution of flows. Head and flow constraints are the same as with base conditions.

5. Total and cleared acres flooded by various frequency floods are presented in Table 1. One particularly significant point is that the 3-year flood inundates almost two-thirds of total lands and over one-third of all cleared lands.

TABLE 1
ATCHAFALAYA BASIN STUDY
ACRES FLOODED
FOR SPECIFIED FREQUENCY FLOODS
PRESENT BASE CONDITIONS

Alternative	Total Acres				Cleared Acres			
	1 Year	3 Year	20 Year	500 Year	1 Year	3 Year	20 Year	500 Year
Red River Back-water Area	253,718	540,084	743,595	848,026	26,808	100,634	209,151	275,076
Percent of Total Area	29.9	63.7	87.7	100.0	9.8	36.6	76.0	100.0

6. Damages - General. Flood damages were estimated for four damageable categories (agricultural crops, agricultural noncrop, roads and bridges, and structural properties). Damages for the first two categories were calculated using a per-acre damage value applied to average annual acres flooded. Damages to the last two categories were determined through preparation of stage-damage curves and integration of these curves with stage-frequency curves to establish damage-frequency relationships. In each case, damages were estimated for both base and with-project conditions.

7. Agricultural Crop Damages.

a. Annual crop damage under present conditions (1978) was determined by multiplying the damage per cleared acre flooded by the average annual cleared acres flooded. The per-acre damage value was calculated by computer analysis utilizing historical flood data, crop distributions and yields, crop budget data, and stage-area data. Program results include the monetary damage to each crop caused by each flood over the historical period of record. The total damage to all crops by all floods divided by the total acres flooded yielded an average damage per flooded acre which ranged from \$22.62 to \$58.33.

b. Average annual cleared acres flooded were determined by frequency analysis through integration of the stage-area and stage-frequency curves. Results indicate that 98,300 cleared acres are flooded annually under base conditions. Application of acres-flooded values

to the per-acre damage estimate yielded crop damages of $2,915,800 in the study area under base conditions. Crop damage estimates are presented in Table 2. Similar estimates were made for with-project conditions. Calculation of future damage values for crops, as well as noncrop items, was based on projected value of farm products sold for an eight-parish area representative of the Red River Backwater Area.

TABLE 2
ATCHAFALAYA BASIN STUDY
FLOOD DAMAGES BY CATEGORY
PRESENT BASE CONDITIONS

Alternative	Agri. Crop	Agri. Noncrop	Road & Bridge	Structures	Total
Red River Back-water Area	2,915,800	342,900	850,300	1,125,000	5,234,000
Percent of Total	55.7	6.6	16.2	21.5	100.0

8. Agricultural Noncrop. Flood damage to farm property other than crops includes damage to fences, drainage systems, farm roads, and land leveling. In the damage evaluation, a composite damage factor per cleared acre flooded for noncrop items was determined and applied to average annual cleared acres flooded to derive annual damages. In calculating the composite factor, the amount of each damageable item per cleared acre was multiplied by the per-unit value, the result of which was applied to percent damage factors to derive per-acre damage to each item. The amount of each damageable item per acre was based

on recent or current studies in the Red River Backwater Area. Soil Conservation Service data were used to estimate the percent flood damage to each item. Individual damages were then summed to arrive at a composite damage factor to noncrop items per cleared acre flooded which ranged from $2.83 to $4.92, depending upon the area involved. Application of the damage factors to average annual acres flooded yielded total damages of $342,900 to the noncrop category under base conditions (see Table 2). Projected value of farm products sold was then utilized to calculate values for future periods.

9. Roads and Bridges. Determination of road and bridge damages involved preparation of stage-damage values for each area and integration of these data with stage-frequency data to construct damage-frequency relationships. In preparing the stage-damage data, previous studies delineating specific floods upon topographic maps were used extensively to estimate the miles of paved and gravel roads at various elevations. The damage per mile by type of road was based on actual damages sustained in and around the area as determined by recent analyses. Computer analysis of the damage-frequency curve yielded existing total annual damages of $850,000 to roads and bridges in the area. As a reflection of projected population trends for the area, road and bridge damages are considered to remain constant throughout the study period.

10. Structural Damage.

a. Land use in the area is similar to other areas of the Mississippi River Delta in that use for agricultural purposes predominates. Extensive rural development in the form of farm residences, associated buildings, etc., occurs throughout the region. Real estate appraisals of property within the study area have been conducted to determine type, number, value, and evaluation of structures. Future land use in the area is expected to parallel that of current use, continuing at a rate determined by personal preferences, economic conditions, seasonal flooding, etc. Thus, data pertaining to number of structures were applied to both present and future periods for with- and without-project conditions.

b. Annual urban and rural structural property damage was determined by use of a computer program entitled Flood Damage for Urban Areas. Input to the program included type, use, descriptive data, value, and estimated floor elevation of each structure affected; with- and without-project hydraulic (stage-frequency) data; and estimated contents value for each type of structure. Stage-damage relationships for various structure types, use, and value are incorporated within the urban damage program. Damage to contents is also considered within the program, with contents calculated as a percent of structural value.

For residential structures, contents were considered to be 40 percent of structure value. Table 2 includes total existing damages to urban and rural structures. Based on guidelines set forth in ER 1105-2-351, application of an affluence factor in the analysis of rural structure damage is not appropriate.

11. Benefits. Following the guidelines of ER 1105-2-351, benifits were based on the period of economic analysis, the period beginning with the estimated initial project operation date and continuing through the economic life of the project (1991-2090). In addition, benefits herein reflect a 50-year growth period and an interest rate of 6-5/8 percent. This rate was applied through appropriate discounting procedures to convert benefits to an average annual basis. Benefits are presented on an average annual basis for each alternative and benefit category. Two major categories of flood control benefits have been evaluated--flood damage reduction (inundation) and intensification.

a. Inundation Benefits. Inundation benefits consist of reduction in damages to development expected to exist under present conditions at the beginning of project operation, and the reduction of damages to additional development under without-project conditions. This reflects additional development anticipated during the period of economic analysis under existing growth conditions. Flood damage reduction

benefits were evaluated on four damageable categories: agricultural crops, agricultural noncrop, roads and bridges, and structural properties. These benefits are based on the difference between without-project damages, summarized in Table 2, and damages remaining after project installation. These values were used to calculate flood damage reduction benefits for 1978 (present year), 1991 (base year), and for 2020 and 2040. Future benefits were converted to average annual values using discounting procedures computerized by personnel of the Lower Mississippi Valley Division. Average annual damage reduction benefits are summarized by alternative benefit category in Table 3 or in the situation of induced damages in Table 4. The percent contribution to total benefits by each benefit category is also included in these tables. The level of inundation benefits vary from \$3,093,800 for Alternative 35 No Head to the point where induced damages of \$3,533,000 result from Alternative 60-40.

b. Intensification Benefits. Intensification benefits result from development potentials created by the project. Flood protection, whether full or partial, reduces the risk involved in farming and allows an intensification in agricultural activities which results in higher yields and, subsequently, greater net returns to land. Intensification benefits as a result of modified operation of the ORCS reflect increases in net productive value per acre which

TABLE 3
ATCHAFALAYA BASIN STUDY
AVERAGE ANNUAL BENEFITS
BY BENEFIT CATEGORY

Alternative	Benefits by Category						Total Average Annual Benefits
	Flood Damages Prevented				Intensification		
	Agri. Crops	Agri. Noncrop	Road & Bridge	Structures	Increased Net Returns	Land Clearing	
45 Acme	584,500	55,300	75,200	154,200	1,490,100	272,000	2,631,300
Percent of Total	22.2	2.1	2.9	5.9	56.6	10.3	100.0
40 Acme	667,900	75,500	113,600	171,900	1,718,500	394,500	3,141,900
Percent of Total	21.3	2.4	3.6	5.5	54.7	12.5	100.0
35 Acme	670,200	86,400	158,600	179,700	1,765,800	525,400	3,386,100
Percent of Total	19.8	2.6	4.7	5.3	52.1	15.5	100.0
35 No Head	2,296,500	214,100	361,300	221,900	6,583,800	1,285,600	10,963,200
Percent of Total	20.9	2.0	3.3	2.0	60.1	11.7	100.0

TABLE 4
ATCHAFALAYA BASIN STUDY
AVERAGE ANNUAL INDUCED DAMAGES
BY DAMAGE CATEGORY

Alternative	Induced Damages by Category						Total Average Annual Induced Damages
	Flood Damages Induced				Reduced Intensification		
	Agri. Crops	Agri. Noncrop	Road & Bridge	Struc-tures	Net Returns	Land Clearing	
65-35 Alternative	1,416,100	129,100	157,900	456,100	3,229,700	0	5,388,900
Percent of Total	26.3	2.4	2.9	8.5	59.9	0	100.0
60-40 Alternative	2,347,200	217,600	251,600	716,600	6,392,900	0	9,925,900
Percent of Total	23.6	2.2	2.6	7.2	64.0	0	100.0

result from better use of the land protected from frequent flooding. Intensification benefits will result from increased agricultural yield levels and conversion of woodland to cropland.

(1) Benefits From Increased Yield Levels. With the use of crop budgets, land use data, and yield level estimates the net returns to all crops were computed for conditions with and without the project. Those acres which are presently being intensively farmed or which will incur frequent flooding under with-project conditions were eliminated from consideration. A difference in the net productive value per-acre with and without the project was calculated for each area. The greatest increase in net productive value per cleared acre ($48.53) occurred in the Below Red River Area. Application of these per-acre values to the number of cleared acres enhanced yielded the basic benefit values for the various alternatives. The benefits were then adjusted to account for increased damages on those acres flooded after project installation and the degree of protection afforded by the project. A similar procedure was used to establish increased net return benefits for future periods. Future values were then converted to an average annual basis by the same methodology used for discounting crop inundation benefits. Average annual net return benefits by alternatives area are presented in Table 3.

(2) Benefits From Conversion of Woodland to Cropland. Frequent flooding of a substantial portion of the woodland acreage hinders the conversion of these lands to agricultural use. Under base conditions, 439,450 wooded acres or about three-fourths of the total woodland in the area is subject to flooding by a 3-year frequency flood. With the reduction in flooding to be provided by four of the six plans of modified project operation, farmers would be able to convert woodland to cropland economically. Project-induced clearing by alternative is presented in Table 5. The estimated acres of woods to be cleared due to each modification were calculated using a composite factor based on the reduction in average annual wooded acres flooded and data obtained from land-use surveys for individual studies in the Red River Backwater Area. The composite factor was applied to the number of wooded acres subject to flooding from the 20-year frequency flood under existing conditions but above the 1-year frequency flood under with-project conditions. The acres were then adjusted to account for degree of protection afforded by each alternative. The number of acres to be cleared was applied to the increase in net productive value per acre to determine annual benefits which were then adjusted to account for damages remaining under each alternative. Average annual benefits to project-induced clearing are included in Table 3. The amount of induced land clearing benefits was restricted by relatively low degrees of

protection on woodland, varying from a high of 42 percent for Alternative 35 No Head to an increased flooding hazard under Alternatives 65-35 and 60-40. In addition to the above, an analysis was conducted to estimate the induced clearing which resulted from going to the present method of operating ORCS (true 70-30 split) as opposed to the previous method for operation (referred to as the observed condition). An estimated 4,900 acres was determined in this analysis.

TABLE 5
ATCHAFALAYA RIVER BASIN
PROJECT-INDUCED LAND CLEARING
BY ALTERNATIVE

Alternative	Alternative				
	35	40	45	35 No Head	70-30
Red River Backwater Area	11,700	7,500	3,900	10,500	4,900

12. Summary of Benefits. Table 6 presents a summary of benefits by alternative. Similarly, Table 6 presents a summary of induced damages for those alternatives creating worse flooding conditions. Total benefits vary from $10,960,000 under Alternative 35 No Head down to induced damages of $9,930,000 under Alternative 60-40.

TABLE 6
ATCHAFALAYA BASIN STUDY
SUMMARY OF AVERAGE ANNUAL BENEFITS
OR INDUCED DAMAGES

Alternative	Benefits ($	Induced Damages ($)
35 No Head	10,963,200	-
35 Acme	3,386,100	-
40 Acme	3,141,900	-
45 Acme	2,631,300	-
65-35	-	5,388,900
60-40	-	9,925,900

State of Louisiana
OFFICE OF THE GOVERNOR
Baton Rouge

DAVID C. TREEN
GOVERNOR

November 5, 1980

Colonel Tom Sands
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

Enclosed is the recommendation of the State of Louisiana on the Land Use Option for the Final Atchafalaya Basin Management Plan.

The proposal recognizes that the first use of the Atchafalaya Basin is as a floodway. Within this context, the state's proposal provides fair and equitable treatment to all of the varied interests concerned with the future of the Atchafalaya Basin. I hope that in developing the Final Management Plan the Agency Management Group will give serious consideration to the proposals of the State of Louisiana.

With warm regard, I am

Sincerely,

David C. Treen

David C. Treen

DCT/lmh

enclosures

ATTACHMENT 2

DAVID C. TREEN
GOVERNOR

State of Louisiana

OFFICE OF THE GOVERNOR

Baton Rouge

STATE OF LOUISIANA
LAND USE PROPOSAL
FOR THE FINAL ATCHAFALAYA BASIN
MANAGEMENT PLAN

Any land use plan adopted for the Atchafalaya Basin must recognize that the basin is first and foremost a floodway. Uses that are inconsistent with the continued use of the basin as a floodway must be prohibited, and actions which are necessary to maintain the basin as a floodway must be given first priority.

The recommended plan involves the obtaining of certain easements over private property in the basin. If in the future it is determined that these easements are no longer necessary, the owner of the property subject to the easements should be given the first option to repurchase them. Where an easement gives the government the right to provide public access to private property, provision must be made to exonerate the private property owner from non-intentional tort liability for incidents arising out of the exercise of that easement.

GENERAL-

Except as specifically provided below, an A-7 Easement should be obtained over all property except developed ridges and State owned property in the basin.

The A-7 Easement would generally provide the following rights in the property:

1) The landowner retains ownership and the right to exploit minerals;
2) The landowner retains the right to control public access;
3) The landowner retains ownership of timber and the right to practice silviculture (as conditioned below);
4) The government would obtain the right to flood the property;
5) The government would control all excavations, landfilling, and uses which change the natural condition of the property (e.g. no clearcutting to convert land to a different use);
6) The government could prohibit permanent habitable structures (other than camps); and
7) Additional uses and structures would be subject to governmental regulation or prohibition.

MINERAL PRODUCTION (OIL AND GAS)-

The A-7 Easement would leave the ownership and right to exploit minerals with the property owner. In accordance with LSA R.S. 31:149, prescription will not run against the property owners. Those rights would have to be exercised in accordance with accepted mineral development practices. It is envisioned that the conditions will be similar to those contained in the Corps of Engineers "Dredge and Fill Permitting Process"(Section 404). Concern has been expressed by certain property owners, particularly the oil and gas industry, that the conditions of exploitation may become so onerous as to be prohibitive. The conditions of exploitation should be worked out in advance and incorporated into the easement and authorizing legislation. The State recommends the conditions contained in Appendix A be so incorporated.

BOTTOMLAND HARDWOODS AND EARLY SUCCESSIONAL BOTTOMLAND HARDWOODS - The A-7 Easement would leave ownership of the hardwoods and the right to practice silviculture with the landowner.

However, the easement should be re-written to specify that those rights would be subject to the following conditions:

1) No land-clearing for conversion to other land uses;
2) No non-regenerative timber cutting; and
3) If silviculture is practiced,it must be on a substainable yield basis.

In addition to the A-7 Easement over the basin, an A-2 Easement should be acquired over 30,000 acres of bottomland hardwoods. The A-2 Easement is the same as the A-7 Easement except:

1) The government would obtain ownership of the bottomland hardwoods; and
2) The government would have the right to provide public access to the property.

The purpose of the A-2 Easement is to set aside this acreage in its natural state and to allow an area of public access for recreation (principally hunting.)

In addition the government should be authorized and encouraged to purchase additional acres on a willing vendor basis.

The acres acquired should be sufficiently contiguous to accomplish the purposes set forth above.

SUMMARY -

A-7 - Generally over basin

A-6 - 30,000 acres Cypress-Tupelo

A-2 - 30,000 acres Bottomland Hardwoods
20,000 acres Cypress-Tupelo Stands
23,000 acres Greenbelts
500 acres Rookeries
A-1 1,500 acres, campsites, unique and special areas

Total - 105,000 acres

CYPRESS-TUPELO STANDS - The A-7 Easement leaves ownership and right to practice silviculture of Cypress-Tupelo stands with the property owner. Again, this easement would have to be re-written to provide that those rights are subject to the three conditions set forth in the section on Bottomland Hardwoods.

With regard to cypress, however, the condition providing for no non-regenerative cutting should aslo include a provision specifying no clearcutting. Serious concern has been expressed over the regenerative ability of cypress. Apparently, it is very difficult to determine if cypress tree cutting is in accordance with a program of sustainable yield, or is in effect a "mining" operation. It is felt that the prohibition of clearcutting of cypress stands and a vigorous program of monitoring by the Louisiana Office of Forestry is necessary to protect cypress from a possible non-regenerative level of cutting. Federal financial assistance may be necessary to properly monitor sustainable yield cutting.

In addition to the A-7 Easement over the basin, an A-2 Easement should be taken on 20,000 acres of Cypress-Tupelo stands and an A-6 Easement over 30,000 acres of Cypress-Tupelo stands. The A-6 Easement would give the government the right to allow public access to the lands, but retain ownership of the Cypress-Tupelo stands and the right to practice silviculture with the property owner.

It is recommended that the government be authorized and encouraged to obtain additional Cypress-Tupelo stands from willing vendors. Again, the acres should be sufficiently contiguous to accomplish the purposes for which they are acquired.

The conditions for practice of silviculture should be worked out in advance and incorporated into the easement and authorizing legislation.

GREENBELTS- It is recommended that two types of greenbelts be created to provide public access to land areas for recreational purposes. These would be A-2 Easements.

1) Greenbelts along specified public navigable waters - The greenbelt would consist of 300 foot-wide strips of land on each side of specified public navigable waters. It must be emphasized that the designation of public navigable waters would be for the purpose of identifying greenbelt areas and not for the purpose of determining ownership to the water or waterbottoms. The greenbelts should incorporate as much cypress-tupelo acreage as feasible.

2) Perimeter-Greenbelts - These greenbelts would consist of land areas up to 1/4 mile wide along specified areas of land inside and adjacent to the Atchafalaya Basin Guide - Levees. Except as provided below, the right would not include access to the levee. The areas considered would be those in which the 1/4 mile or less width would bring the perimeter greenbelt into contact with water. Certain areas would be specified for controlled access over the levee to the greenbelt.

The designation of a perimeter greenbelt is not to interfere with the governments right to engage in flood control activities on that property. This specifically includes the right to obtain material from the property for levee construction.

The total area set aside for the two types of greenbelts would be 23,000 acres.

The greenbelt property would be subject to the conditions of an A-2 easement. Public access includes the right of owners of property landward of a greenbelt area to cross the greenbelt to exercise on the landward property any right they would have under an A-7 Easement. Also, the existing right of the landowner to establish a camp on his property and fence off a reasonable area for privacy would not be abridge by the obtaining of the A-2 Easement for a greenbelt.

CAMPSITES, BOAT LAUNCH AREAS, ROOKERIES, SPECIAL AND UNIQUE AREAS -

Rookeries - An A-2 Easement should be obtained over 500 selected acres of rookeries.

Campsites, boat launch areas, special and unique areas - An A-1 Easement should be obtained over 1500 acres for campsites, boat launch areas and special and unique areas. An A-1 Easement would give the government fee simple title to the land. However, it would reserve mineral rights to the original property owner. In accordance with LSA R.S. 31:149, prescription will not run against the property owners.

Since the primary method of public access to the basin is by boat, every effort should be made to maximize the number of boat launch areas in the basin.

WATER ACCESS - An important element of public access in the basin is access by water to overflow lands flooded during seasonal high waters. The legal right to this access is unclear. The Louisiana Attorney General is urged to issue a legal opinion clarifying the right of public access by water to overflow lands. If this right does not exist, an A-6 Easement would be necessary to provide comparable access.

STATE OWNED LANDS - The State of Louisiana will maintain the state lands in the basin open for public recreational access. State title shall not be prejudiced by another government's acquisition of an easement from private claimants to any of these same lands. Language to this effect should be incorporated in all easements.

MANAGEMENT - The working group believes that management of non-flood control elements of the final Atchafalaya Basin Plan should be through State of Louisiana agencies.

percent of the basin or 240,000 acres would be preserved for posterity, while meeting the objectives of flood control and legitimate objectives of private ownership.

Significant questions answered by Governor Treen follow.

In explaining the difference between the tightened easement and the one described in the other plan, Governor Treen agreed to support a non-conversion position so that any major industrial, residential or commercial use would require approval by the Congress.

In response to assuming success in concluding the deal with the landowners; what would be the next step, Governor Treen indicated that when written agreements of the landowners were completed and he was satisfied with having a funding mechanism, he would recommend substitution of the compromise plan. He further stated that the Corps of Engineers is very receptive to this substitute, and Federal funding will be required. He indicated that the state legislature will have to approve by appropriation any matching funds, and if the purchase is 50-55 million dollars, the various matches could be figured starting with a 90-10 proposition with the Federal government.

The press conference concluded with questions regarding Secretary Watt's visit.

APPENDIX A

Oil and Gas Activities in the Atchafalaya Fish, Wildlife, and Multi-Use Area

The United States Department of the Interior's Fish and Wildlife Service, in proposing the Atchafalaya Fish, Wildlife and Multi-Use Area, recognizes that oil and gas activities would be fully compatible with any operational, multipurpose plan established for that area. It is, therefore, the intent that such activities, within the area, will not be subject to any additional restrictive regulations affecting oil and gas activities.

Furthermore, mineral owners, mineral lessees and pipeline companies shall have the right to use surface and subsurface property of the Atchafalaya Fish, Wildlife and Multi-Use Area as may be necessary for the conducting of operations for the exploration, development, production, storage, transportation and marketing of oil, gas and other liquid or gaseous minerals, including but not limited to, the construction, maintenance and operation of wells, pumping units, pipelines, storage tanks, valves, meters and other above or below ground facilities relating to such exploration, development, production, storage, transportation, or marketing. In addition, this right shall particularly include, but shall not be limited to, the following actions where normally associated with oil and gas exploration, development, production, storage, transportation, or marketing:

(1) access to all parts of the Atchafalaya Fish, Wildlife, and Multi-Use Area on a year-round basis;

(2) access via all navigable waterways;

(3) right to dredge, maintain, and use canals as needed for the exploration for and production and transportation of oil, gas, and other liquid or gaseous minerals;

(4) with respect to the construction, use, and maintenance of production facilities, the right to:

- a) dike and fill
- b) place facilities on pilings

(5) the right to construct, maintain, operate, and use pipelines and flowlines for the transportation of oil, gas, water (salt or fresh), and other liquid or gaseous minerals. The pipelines and flowlines will be constructed in accordance with standards prevailing in the industry;

(6) where land access is available to a location, the right to construct, use and maintain suitable roads. Water levels in management units shall be regulated, as closely as possible, to simulate natural overflow patterns, thus facilitating coordinated planning of such road locations and elevations with water management plans;

(7) the right to construct, use, and maintain electric utility and telephone lines;

(8) the right to drill, use and maintain wells for the disposal of produced water;

(9) the right to excavate, use, and maintain pits and other facilities normally needed in connection with oil and gas exploration and production operations;

(10) the right to conduct or have conducted geological surveys including those that require the use of explosives;

(11) the right to dispose of drilling muds and other waste in the manner and to the extent required by State and Federal law.

SUMMARY
GOVERNOR'S ATCHAFALAYA BASIN PLAN
PRESS CONFERENCE OF 19 NOVEMBER 1981

A handout furnished the conference attendees contained the following information.

BASIC ELEMENTS

1. Dow donation in excess of 40,000 acres of land in and around the basin.

2. Landowners agreeable to selling the state at least 48,000 plus acres.

3. Tightened A-7 easement to cover the entire basin to prevent conversion of basin from its natural state.

4. 40 percent of the basin will be open to public access.

5. The A-7 easement (flood control) will be funded 100 percent by the Federal government. For recreation, wildlife and other multi-purpose uses, the state is indicating a willingness to share the cost with the Federal government. Cost to the state will be a percentage of $50 to $55 million for land acquisition with the Federal government funding the rest.

6. All major groups involved in the Atchafalaya Basin are supportive of this plan.

Governor David C. Treen made opening remarks. He indicated he had important announcements consisting of several elements regarding the Atchafalaya Basin, news that was very good and exciting for Louisiana. First and most important was the announcement by Dow Chemical Company of a donation of approximately 45,000 acres in and around the basin. Also, an understanding has been reached with prinicpal landowners in the basin for a method of acquisition of 40,000 plus acres in the basin. In addition, an agreement with the environmental community with regards to the A-7 easement has led to the plan which will resolve all of the issues in the basin. All the rest was resolved assuming that this plan can ultimately be put in effect. If so, it would meet all of the needs, aspirations and hopes of all concerned with the Lower Atchafalaya Basin.

Governor Treen introduced Mr. Bill Neeley, the General Manager of the Louisiana Division of Dow Chemical Company, and Mr. Steve Haggard of Dow. Mr. Neeley expressed pleasure at announcing the Dow donation, well in excess of 45,000 acres in or near the basin, for the benefit of the people of Louisiana. It was deemed an appropriate expression of appreciation for the excellent climate and favorable reception experienced by Dow on its 25th anniversary of doing business in the state.

Next Governor Treen explained a map depicting the Dow land donation and land presently owned by the state. He indicated he would answer questions after completion of statements by those wishing to speak. Governor Treen proceeded to give background on the plan. He explained that he made a recommendation to the Agency Management Group in November 1980 that involved flood control,

ATTACHMENT 3

public access through easements, and tried to address the problem of minimizing the taking of lands in private ownership. He viewed this as the catalyst for the further discussions after learning of Dow's intentions several months ago. There was concern by hunters about the "greenbelts" included in the earlier plan. Other concerns were expressed by wildlife people who preferred full acquisition rather than easements to provide for better management. The discussions were continued with Mr. Trowbridge representing the landowners and he began to identify areas in the basin that they would be willing to sell. Governor Treen identified Alabama Bayou and Henderson, and mentioned scattered acreage throught the basin totaling between 40,000 and 50,000 acres of very prime area. He next explained that under present policies of the administration in Washington, to expect 100 percent Federal funding for this entire plan was not realistic. He expressed belief that the flood control portion will be 100 percent Federal funding. Summarizing developments, the Governor agreed to accept with gratitude the Dow donation; to work with landowners through Mr. Trowbridge to get in writing offers to sell the acreage clearly identified and price discussed; to tighten up the A-7 easement over everything else in the basin; and to seek state and Federal funds on a matching basis. Governor Treen announced that Secretary of the Interior James Watt would tour the basin on Saturday with him and that the media would be invited. He closed by emphasizing that this was a complete plan for multiple uses of the basin and had the support of all those involved, the naturalists, environmentalists, landowners, the Treen Administration, and the people interested in flood control.

Governor Treen then introduced Mr. Newman Trowbridge, representing the Louisiana Landowners Association. Mr. Trowbridge indicated that landowners will find the plan very acceptable. Private property rights will be protected by the willing seller concept, and habitat protection will be provided by the A-7 easement.

Mr. Foster Sanders of Save the Atchafalaya Basin, Inc. was next introduced and announced the support of his and other sportsmen and civic groups for the compromise plan.

Mr. Oliver Houck of the National Wildlife Federation followed, speaking on behalf of many national-based conservation organizations. He stated that the plan would receive strong national recognition and support.

Mr. Charles Frying then spoke on behalf of the Sierra Club and Audubon Society, applauding Governor Treen's efforts in reaching resolution of this very difficult issue.

Mr. Edgar Viellon of the Louisiana Wildlife Federation was introduced and indicated gratitude to all involved in bringing to successful conclusion a 10-year long emotional battle.

Governor Treen acknowledged the work of his staff members, Mr. Kai Midboe, in helping make this announcement a reality, and Mr. Jesse Guidry, who would administer public access of the area. Mr. Guidry reflected back upon a public meeting in 1975, when the same people were there but of opposing interests, and pledged to work toward accomplishing the plan.

The Governor closed the general remarks by emphasizing that at least 40

COMPREHENSIVE MULTIPURPOSE EASEMENT

The perpetual right, power, privilege and easement to overflow, flood and submerge by natural or artificial means for any designated time or indefinite time the lands described herein as Tract Nos. ________, in connection with the operation and maintenance of the ______________ project as authorized by the Act of Congress approved __________________, providing further that there will be no land converted from existing uses for agricultural, industrial, or residential purposes; for activities conducted by the State of Louisiana in its sovereign capacity and for other activities not mentioned in this easement except upon a written finding by the representative of the United States in charge of the project that there is no feasible or prudent alternative to the conduct of these activities within the Floodway; for activities by the State or private interests of a recreational or commercial nature directly related to the use and enjoyment of the renewable natural resources of the Floodway except upon the representative's finding that these activities are fully consistent with the project and the preservation or enhancement of natural conditions, provided that no structures for permanent human habitation shall be constructed or maintained on the land, and provided, further, that construction of seasonal dwellings by private interests shall be permitted with written approval hereunder; for other activities by state and private interests except those necessary for the exploration, production, development, storage, extraction, marketing, and transmission of oil, gas and/or other minerals as described in the referenced appendix, and for the production of timber as described below and in the referenced appendix, and for other activities by private interests except those relating to the mineral, timber, wildlife management and public access rights retained by the landowner under this agreement.

Landowner shall retain title to timber, the right to manage timber on a sustained yield basis following prudent and current state of the art forestry practices, and the right to control ingress and egress relating to the land, and landowner shall retain the right to practice wildlife management, including the right to undertake wildlife habitat enhancement measures and to grant hunting, trapping and fishing leases, reserving, however, to the vendor(s), their heirs and assigns, all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress, or abridging the rights and easement hereby acquired. Provided further, that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill and that any use of the land shall be subject to Federal and State laws with respect to pollution control, environmental protection and fish and wildlife conservation; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads, pipelines; excepting and excluding all minerals and appurtenant rights; in the event that the Secretary of the Army, his successor or assign shall determine that the useful life of the floodway has ceased to exist and that it is in the public interest, he will execute an appropriate instrument to terminate or release the government's easement to the grantors, their heirs, successors or assigns.

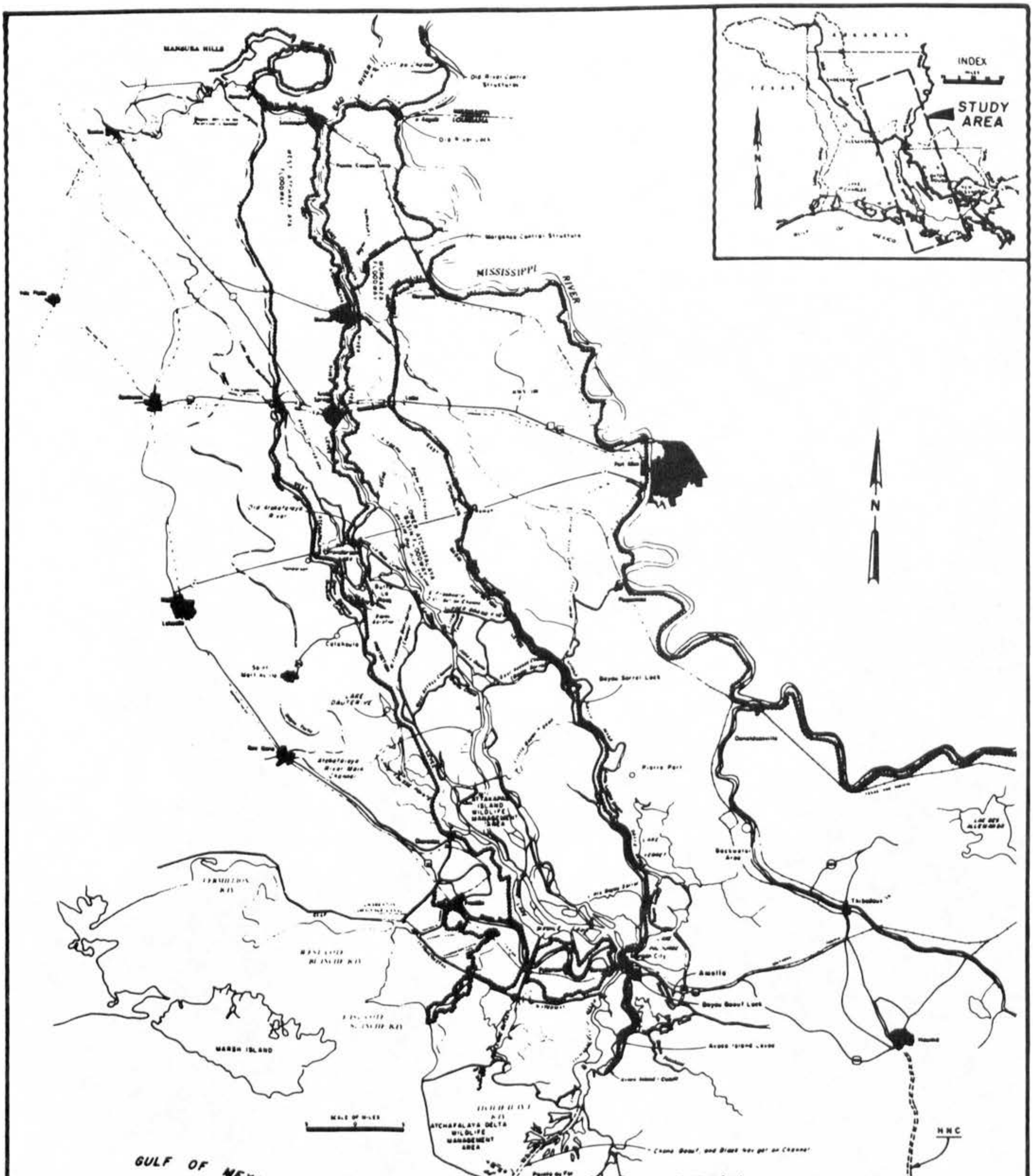
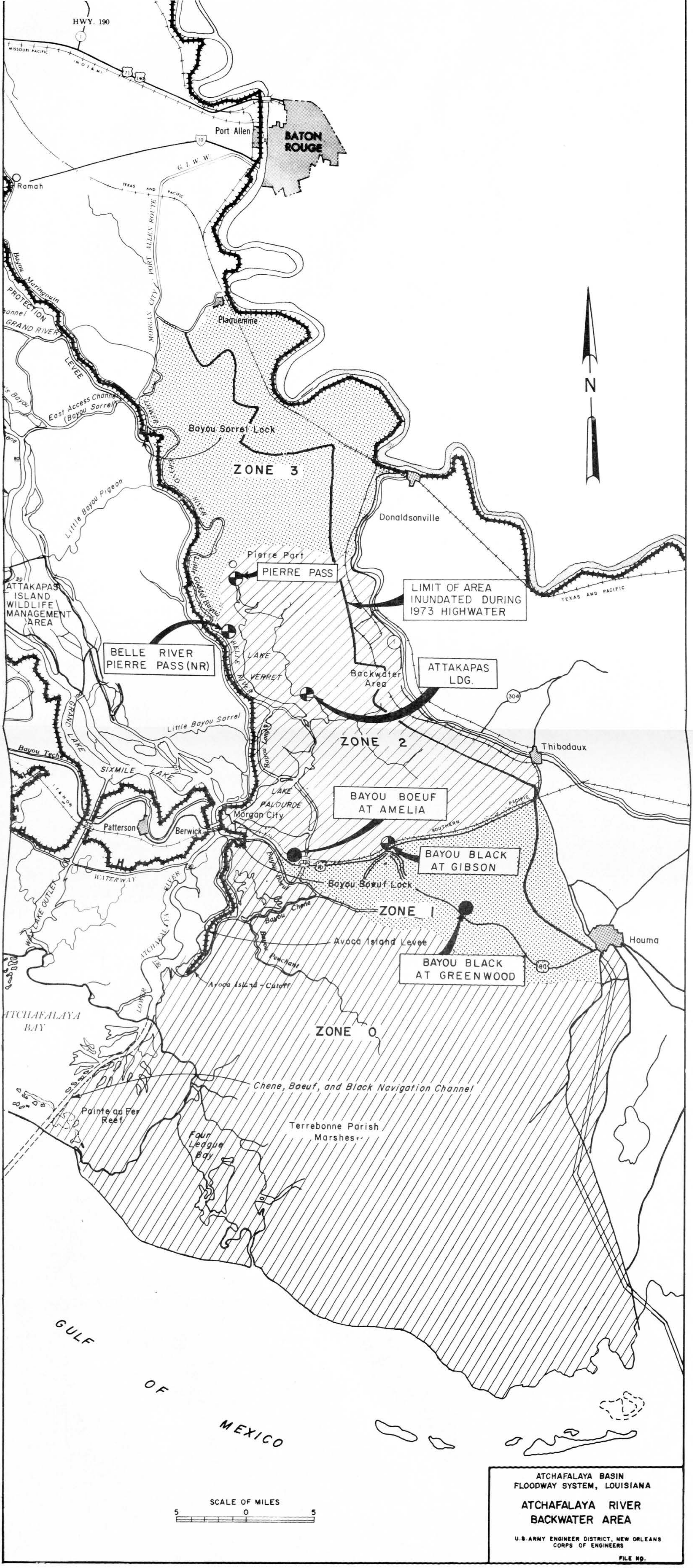

INDEX
STUDY AREA
N
MISSISSIPPI RIVER
GULF OF MEXICO
MARSH ISLAND
ATCHAFALAYA DELTA WILDLIFE MANAGEMENT AREA
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
Morganza Control Structure
Bayou Sorrel Lock
Bayou Boeuf Lock
Amelia
Donaldsonville
Pierre Part
Catahoula
Atchafalaya River Main Channel
Avoca Island Levee
HNC
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
GENERAL MAP
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-1



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA RIVER
BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-2

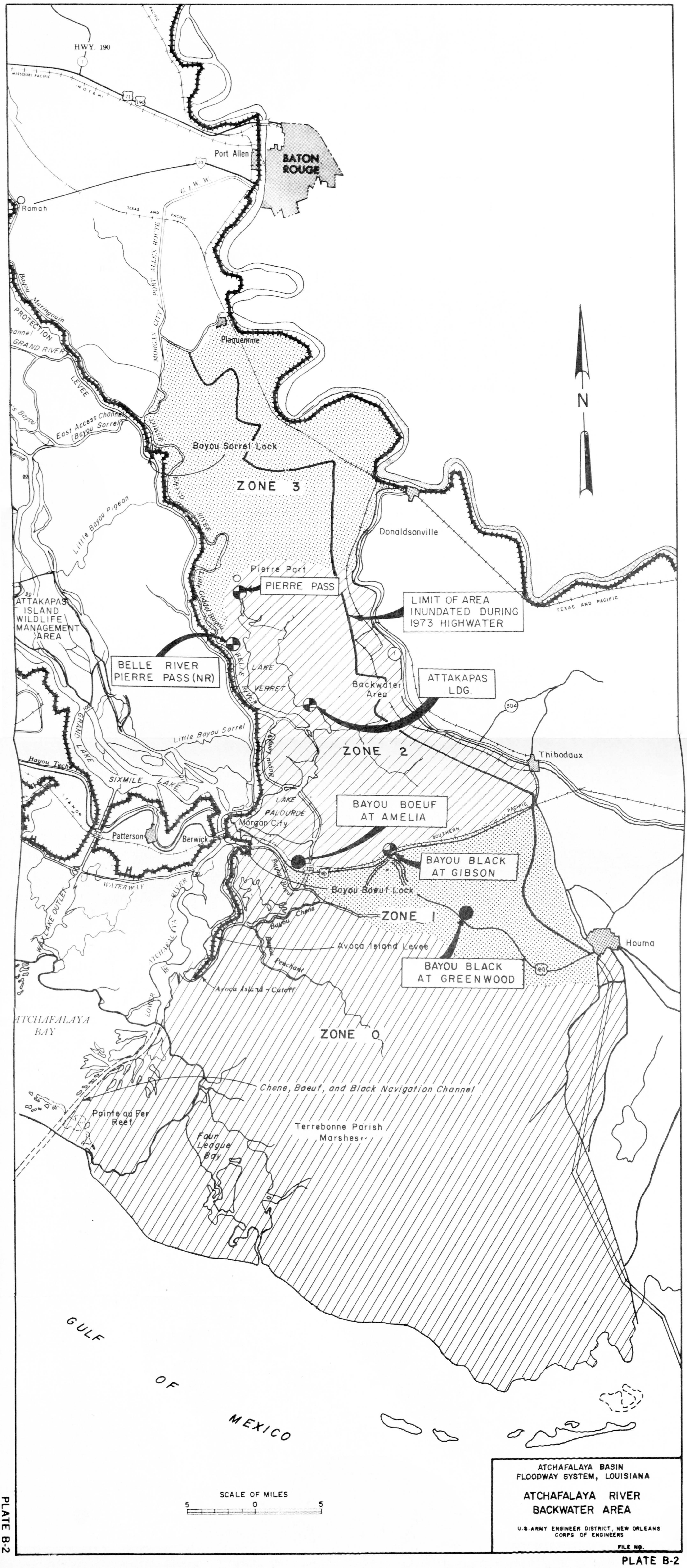


PLATE B-2

PLATE B-2

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RING LEVEE ALTERNATIVE FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

LEGEND

RINGED AREAS

SCALE OF MILES

1/2 0 1

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

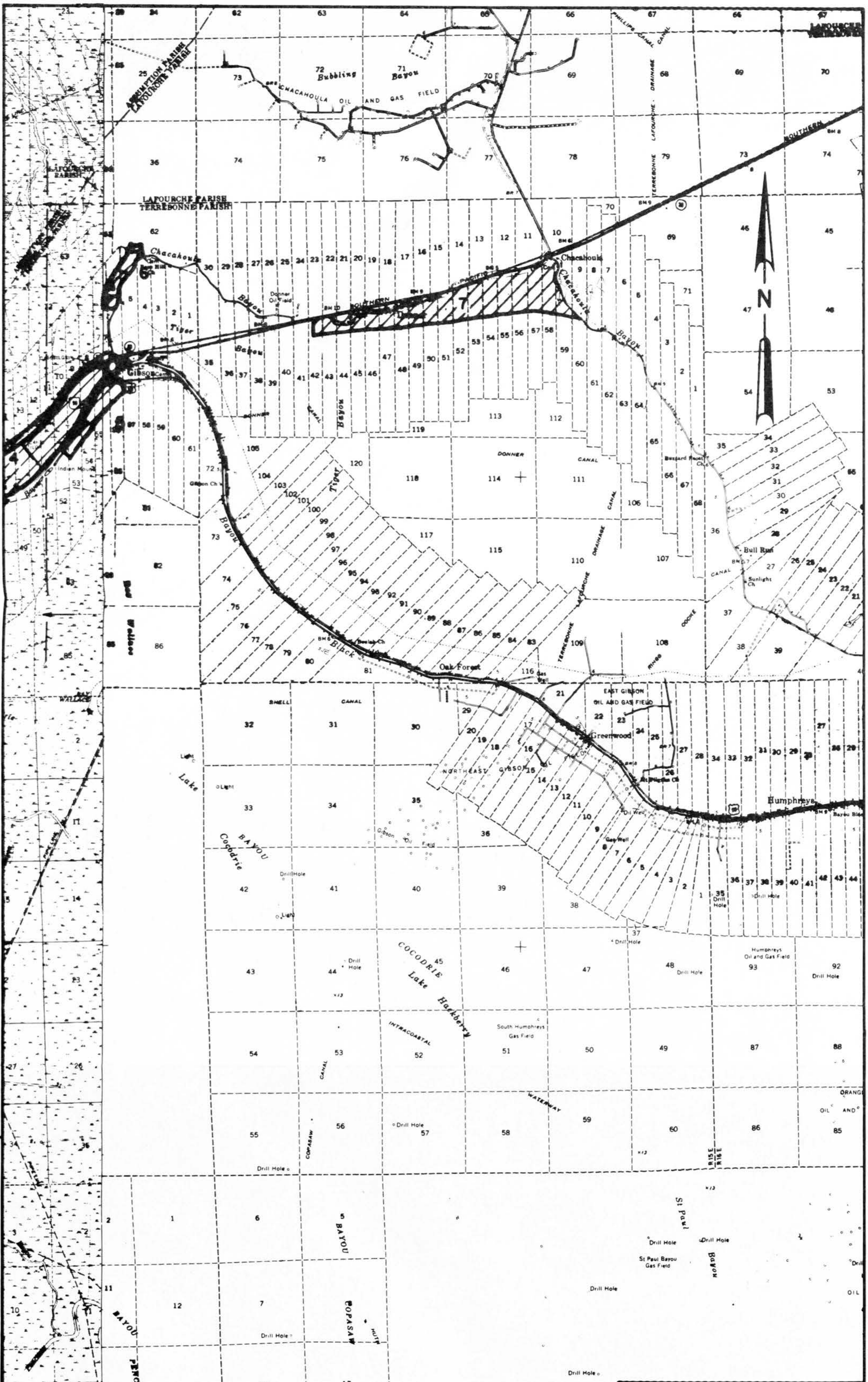
RING LEVEE ALTERNATIVE
FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-4

MATCH PLATE B-4



LEGEND

RINGED AREAS

SCALE OF MILES

1/2 0 1

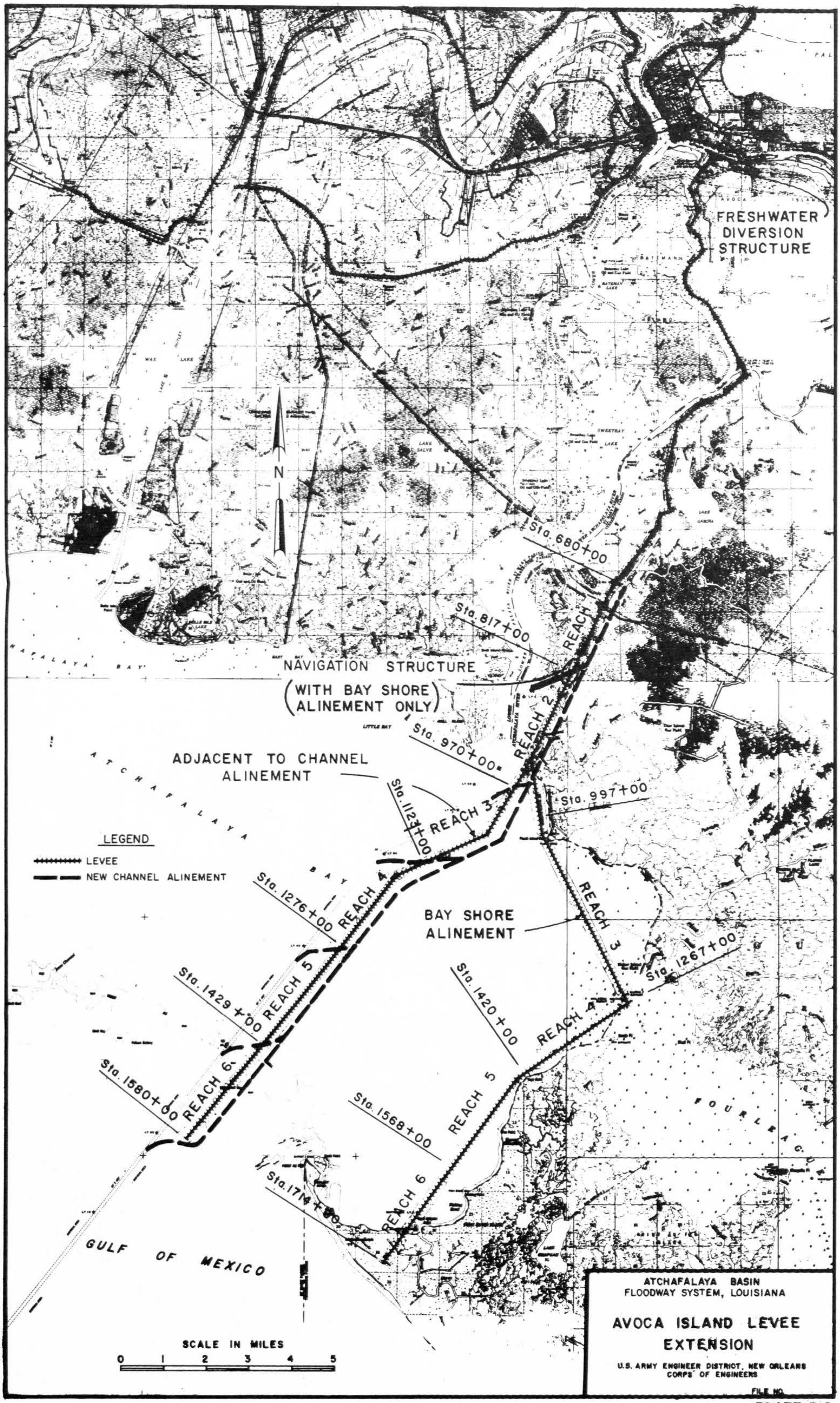
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RING LEVEE ALTERNATIVE
FOR BACKWATER AREA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-5



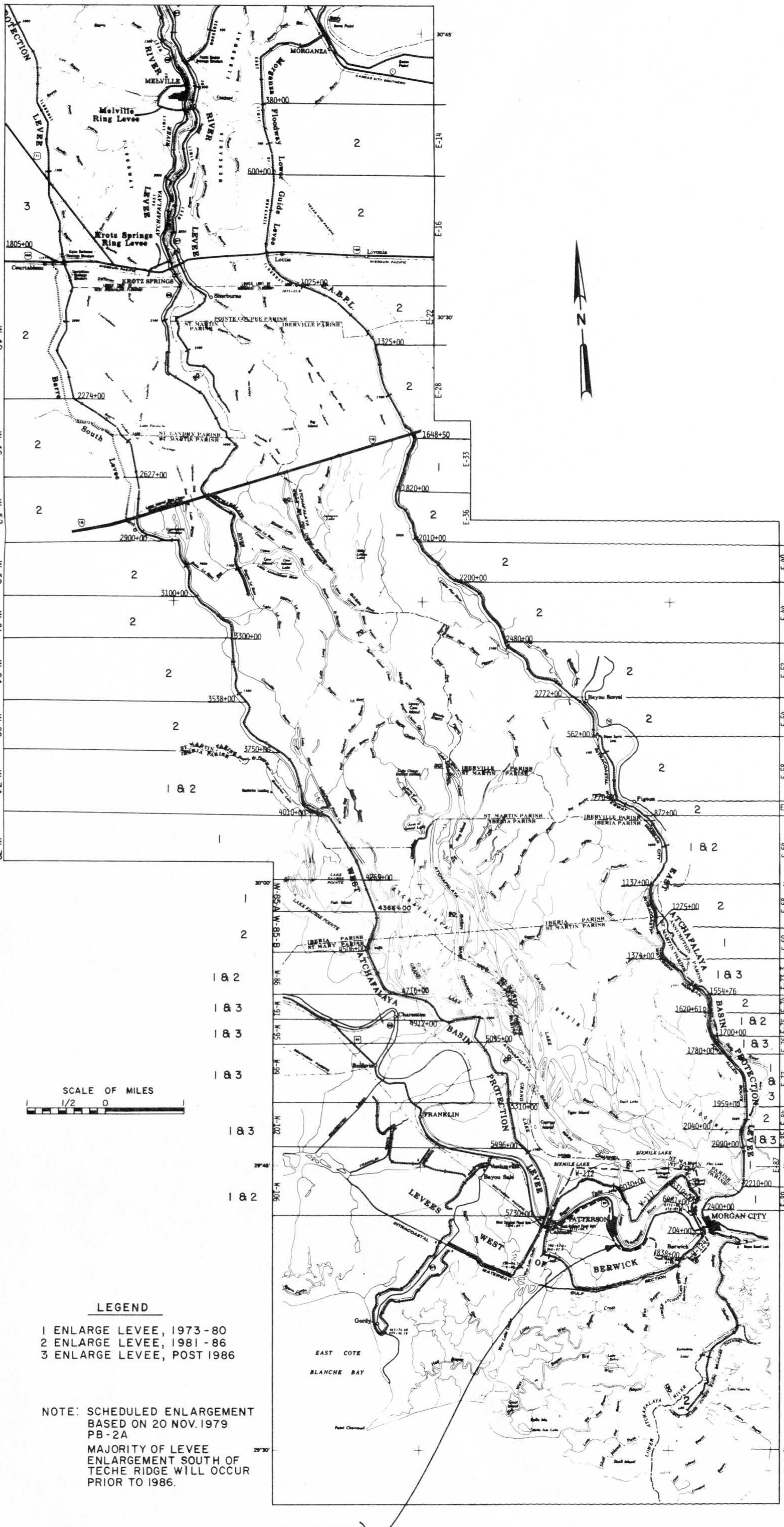
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

AVOCA ISLAND LEVEE EXTENSION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-6



LEGEND

1 ENLARGE LEVEE, 1973-80
2 ENLARGE LEVEE, 1981-86
3 ENLARGE LEVEE, POST 1986

NOTE: SCHEDULED ENLARGEMENT BASED ON 20 NOV. 1979 PB-2A

MAJORITY OF LEVEE ENLARGEMENT SOUTH OF TECHE RIDGE WILL OCCUR PRIOR TO 1986.

W-112 1 & 3
W-117 1
W-121 1
W-123 2
W-124 2

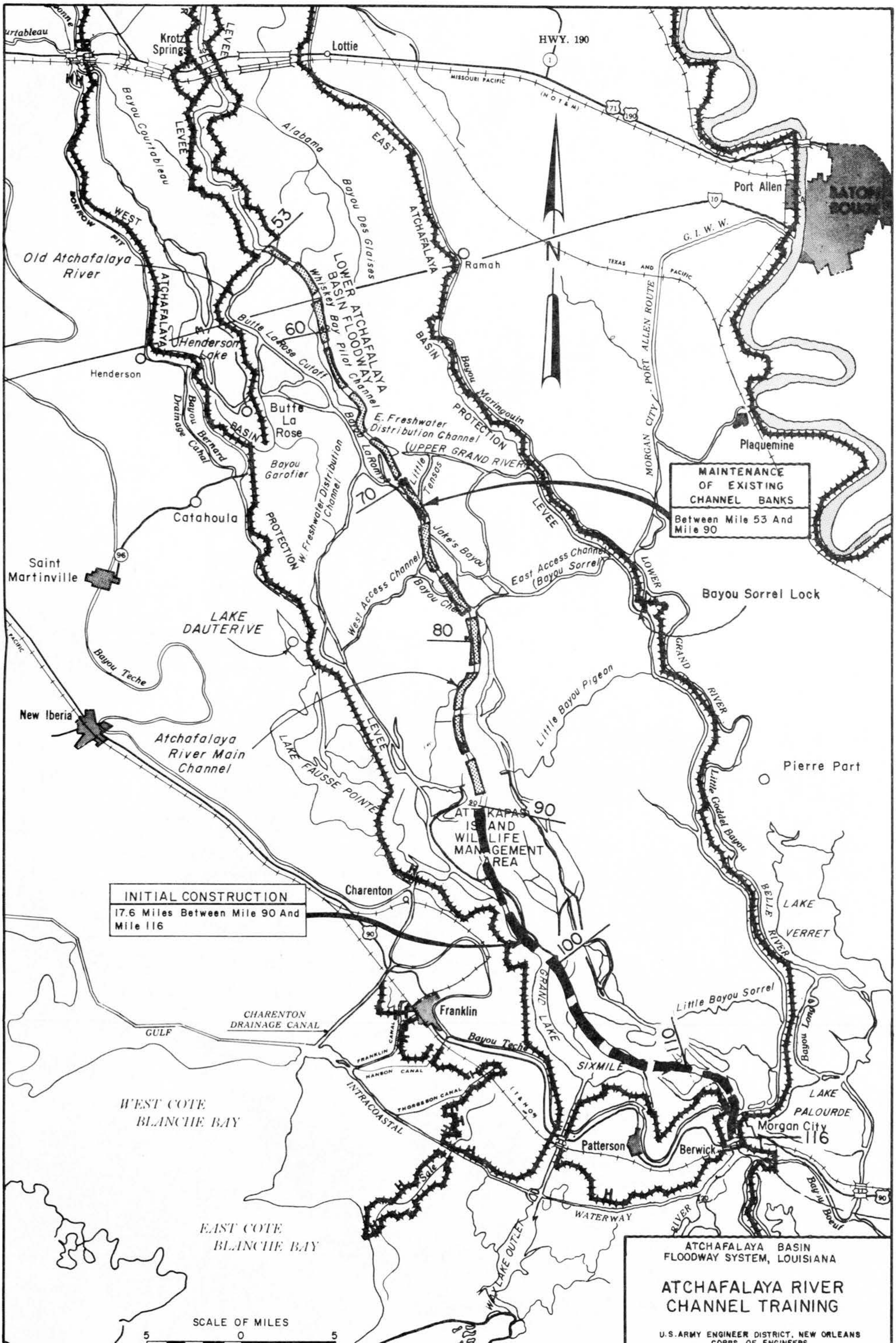
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MODIFICATION OF EXISTING LEVEE FEATURES

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE B-7



Krotz Springs
Lottie
HWY. 190
MISSOURI PACIFIC
Port Allen
BATON ROUGE
Bayou Courtableau
Alabama
Bayou Des Glaises
EAST
ATCHAFALAYA
BASIN
PROTECTION
LEVEE
WEST
ATCHAFALAYA
Old Atchafalaya River
53
60
70
80
90
100
110
116
LOWER ATCHAFALAYA BASIN FLOODWAY
Whiskey Bay Pilot Channel
Ramah
TEXAS AND PACIFIC
G. I. W. W.
MORGAN CITY - PORT ALLEN ROUTE
Henderson Lake
Henderson
Butte La Rose Cutoff
Butte La Rose
Bayou Maringouin
Bayou Bernard
Drainage Canal
E. Freshwater Distribution Channel
(UPPER GRAND RIVER)
Plaquemine
MAINTENANCE OF EXISTING CHANNEL BANKS
Between Mile 53 And Mile 90
Bayou Garofier
W. Freshwater Distribution Channel
Little Tensas
Catahoula
Saint Martinville
Jake's Bayou
West Access Channel
East Access Channel (Bayou Sorrel)
Bayou Sorrel Lock
LAKE DAUTERIVE
Bayou Teche
New Iberia
Little Bayou Pigeon
GRAND RIVER
Atchafalaya River Main Channel
LAKE FAUSSE POINTE
Pierre Part
Little Goddel Bayou
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
INITIAL CONSTRUCTION
17.6 Miles Between Mile 90 And Mile 116
Charenton
BELLE RIVER
LAKE VERRET
GRAND LAKE
Little Bayou Sorrel
Franklin
CHARENTON DRAINAGE CANAL
GULF
FRANKLIN CANAL
HANSON CANAL
THORGSON CANAL
INTRACOASTAL
WATERWAY
SIXMILE LAKE
LAKE PALOURDE
Morgan City
Patterson
Berwick
Bayou Boeuf
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
WAX LAKE OUTLET
SCALE OF MILES
5 0 5
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA RIVER CHANNEL TRAINING
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO
PLATE B-8

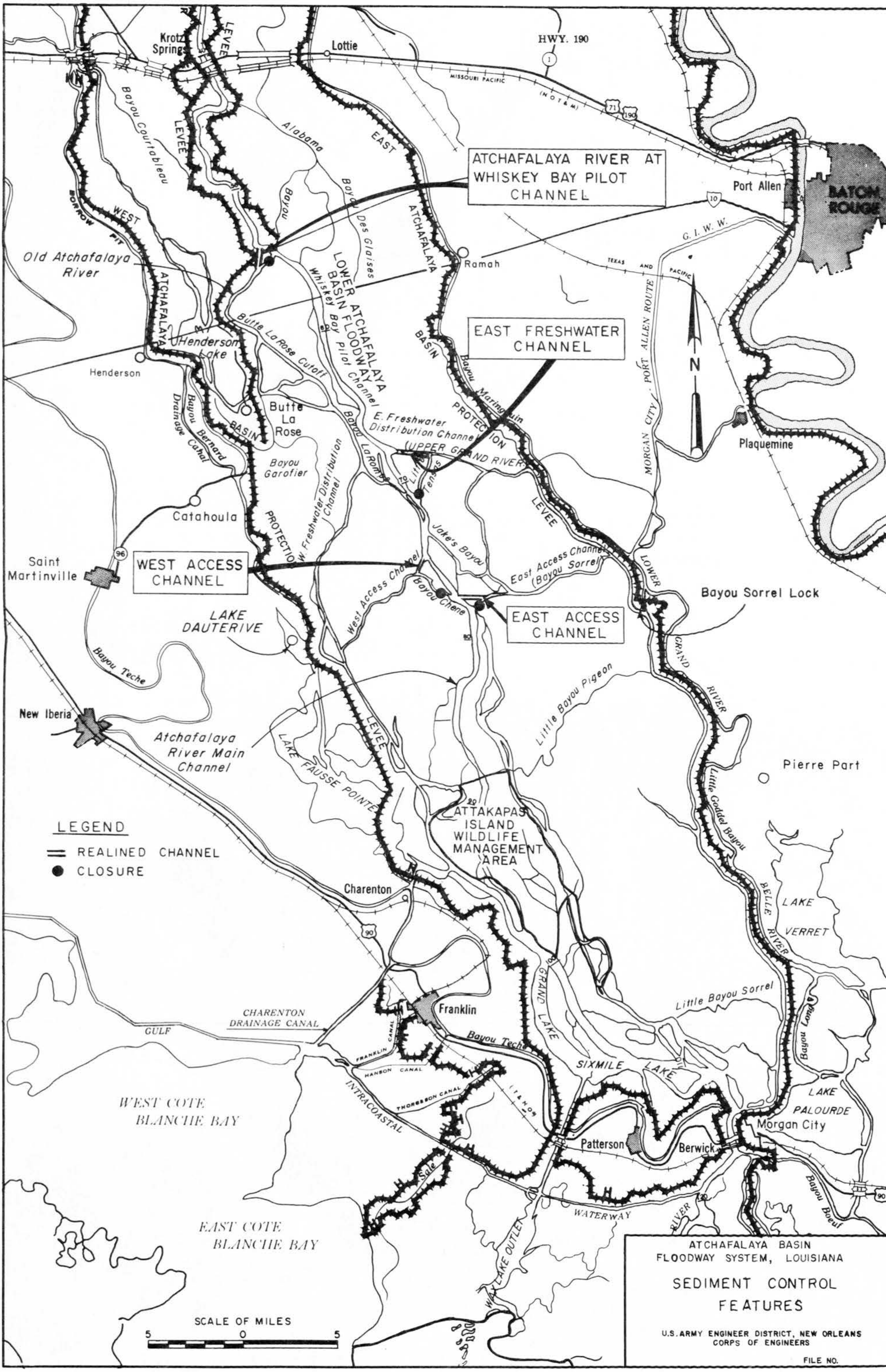
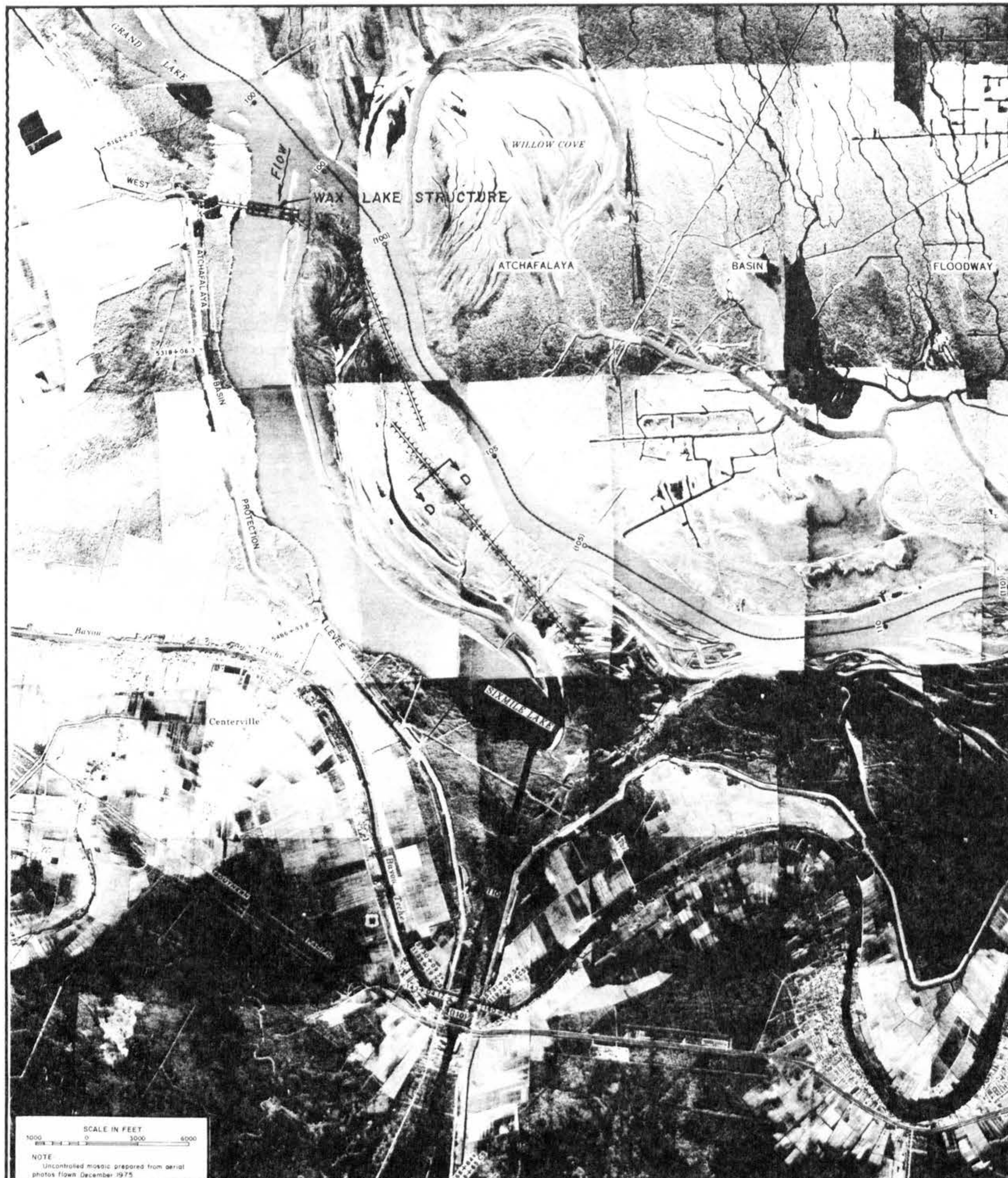
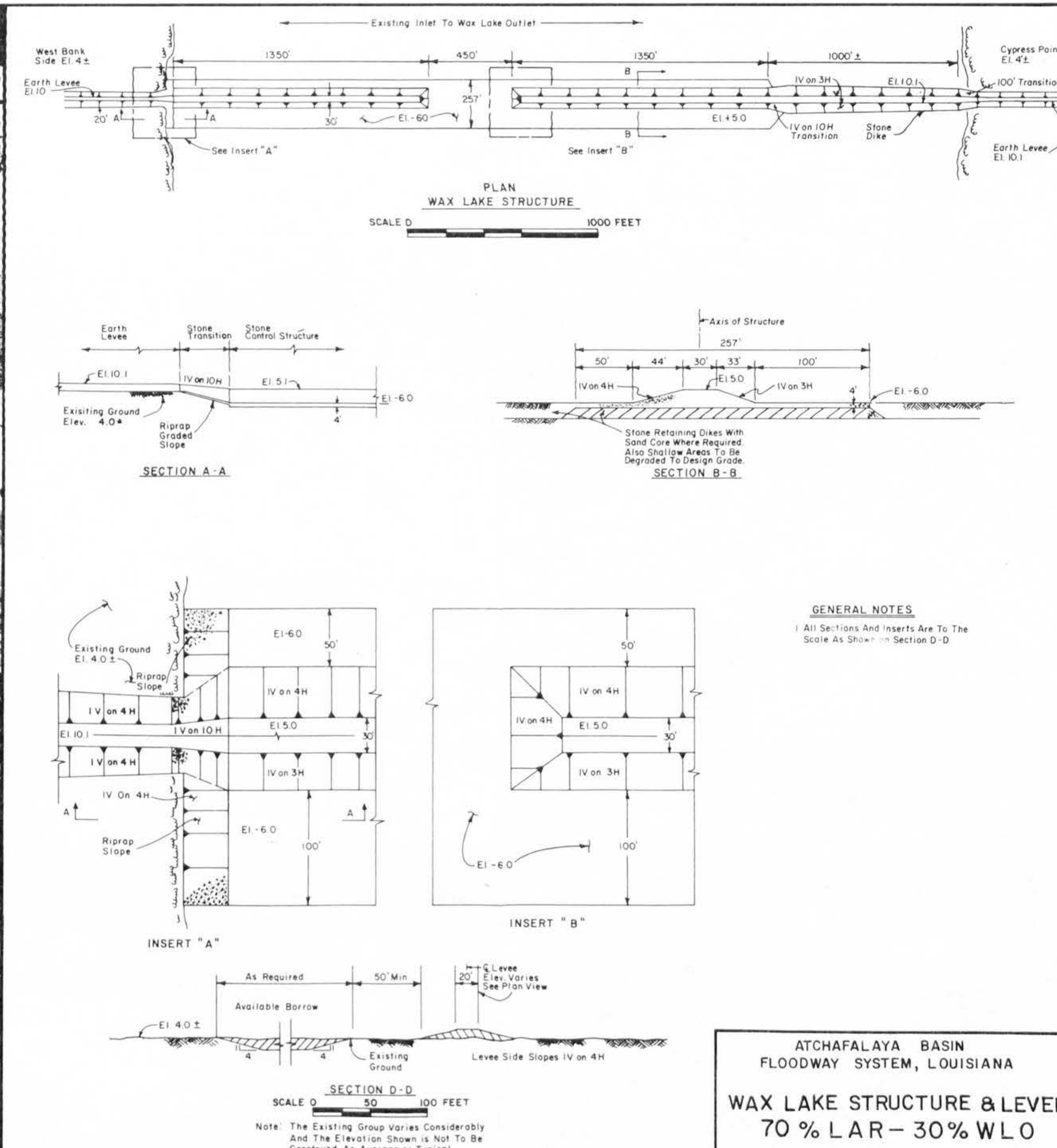

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
SEDIMENT CONTROL
FEATURES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.
LEGEND
REALINED CHANNEL
CLOSURE
SCALE OF MILES
5
0
5
ATCHAFALAYA RIVER AT
WHISKEY BAY PILOT
CHANNEL
EAST FRESHWATER
CHANNEL
WEST ACCESS
CHANNEL
EAST ACCESS
CHANNEL
Krotz Springs
Lottie
HWY. 190
MISSOURI PACIFIC
(N O T & M)
Port Allen
BATON ROUGE
G. I. W. W.
TEXAS AND PACIFIC
Ramah
Henderson
Henderson Lake
Butte La Rose
Butte La Rose Cutoff
Catahoula
Saint Martinville
LAKE DAUTERIVE
Bayou Teche
New Iberia
Atchafalaya River Main Channel
LAKE FAUSSE POINTE
Old Atchafalaya River
Bayou Courtableau
BORROW PIT
WEST ATCHAFALAYA BASIN PROTECTION LEVEE
EAST ATCHAFALAYA BASIN PROTECTION LEVEE
LOWER ATCHAFALAYA BASIN FLOODWAY
Whiskey Bay Pilot Channel
Alabama
Bayou Des Glaises
Bayou Maringouin
E. Freshwater Distribution Channel
(UPPER GRAND RIVER)
Little Tensas
Bayou La Rompe
W. Freshwater Distribution Channel
Bayou Garofier
Bayou Bernard Drainage Canal
Jake's Bayou
West Access Channel
East Access Channel (Bayou Sorrel)
Bayou Chene
Bayou Sorrel Lock
MORGAN CITY - PORT ALLEN ROUTE
Plaquemine
N
LOWER GRAND RIVER
Little Bayou Pigeon
Pierre Part
Little Goddel Bayou
BELLE RIVER
LAKE VERRET
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
Charenton
GRAND LAKE
Little Bayou Sorrel
Bayou Long
LAKE PALOURDE
Franklin
Bayou Teche
CHARENTON DRAINAGE CANAL
GULF
FRANKLIN CANAL
HANSON CANAL
THORESSON CANAL
INTRACOASTAL
WATERWAY
SIXMILE LAKE
Patterson
Berwick
Morgan City
Bayou Boeuf
WAX LAKE OUTLET
RIVER
Sale
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY

PLATE B-9





GENERAL NOTES

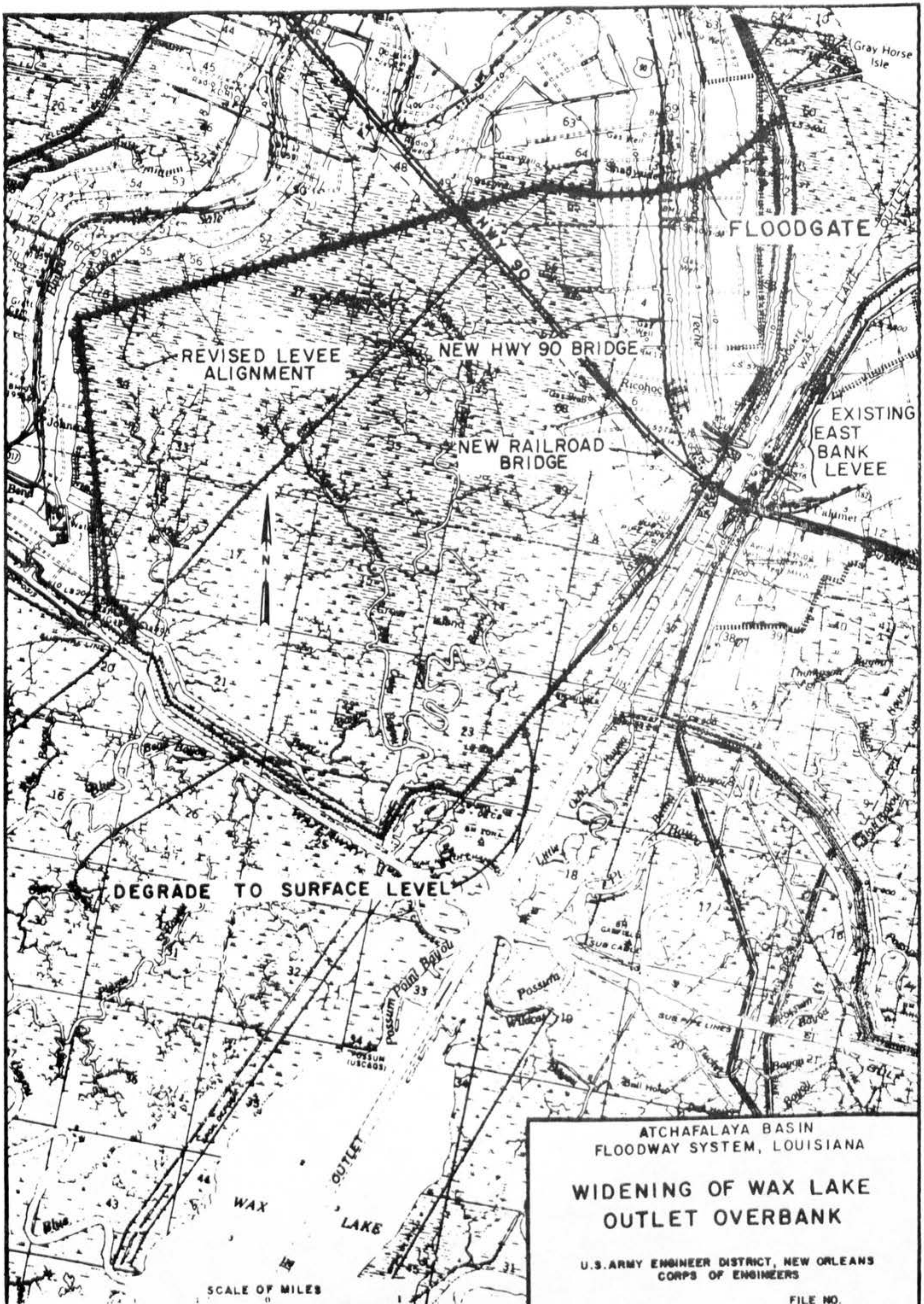
1. All Sections And Inserts Are To The Scale As Shown on Section D-D.

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WAX LAKE STRUCTURE & LEVEE
70% LAR – 30% WLO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WIDENING OF WAX LAKE
OUTLET OVERBANK

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

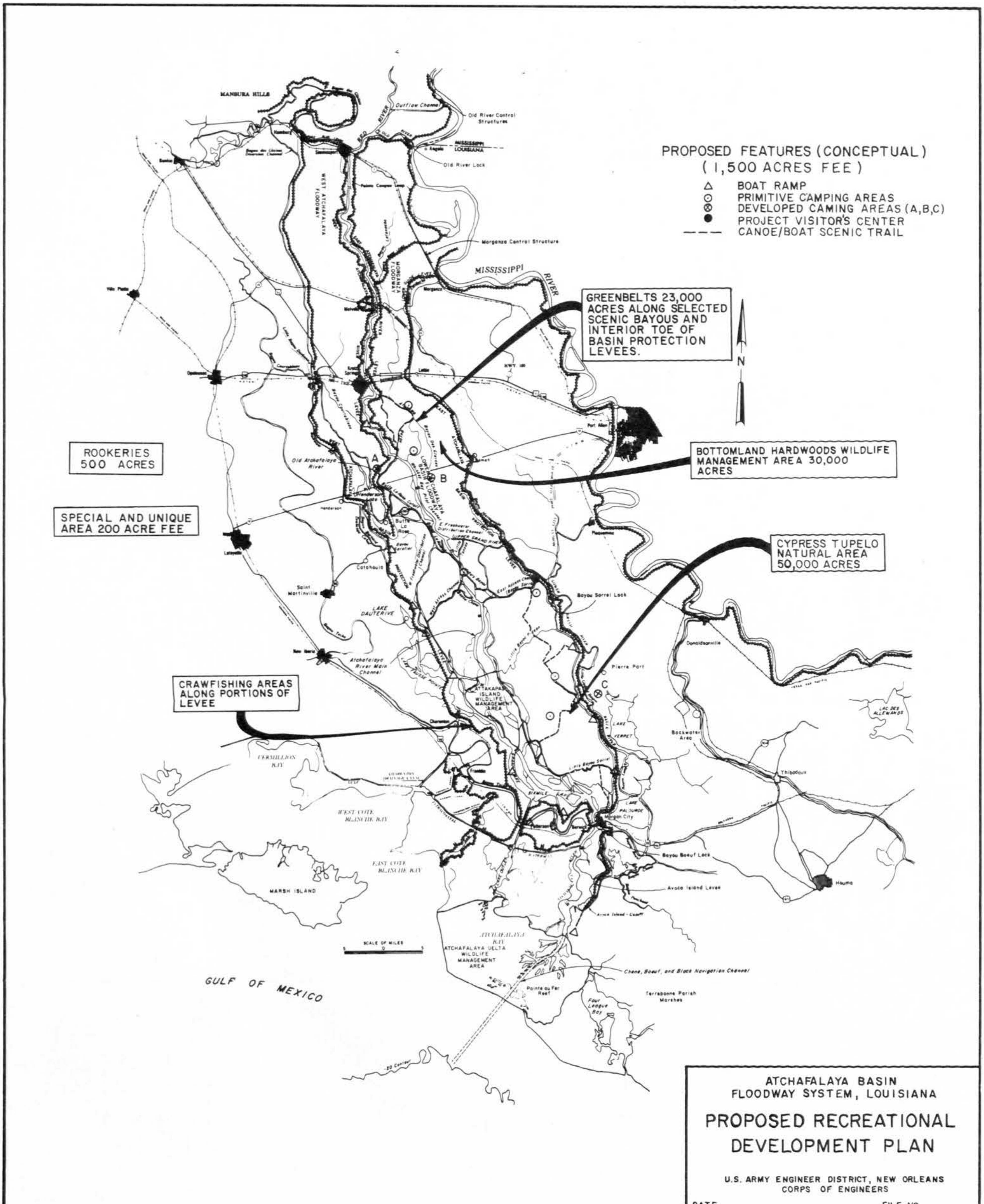
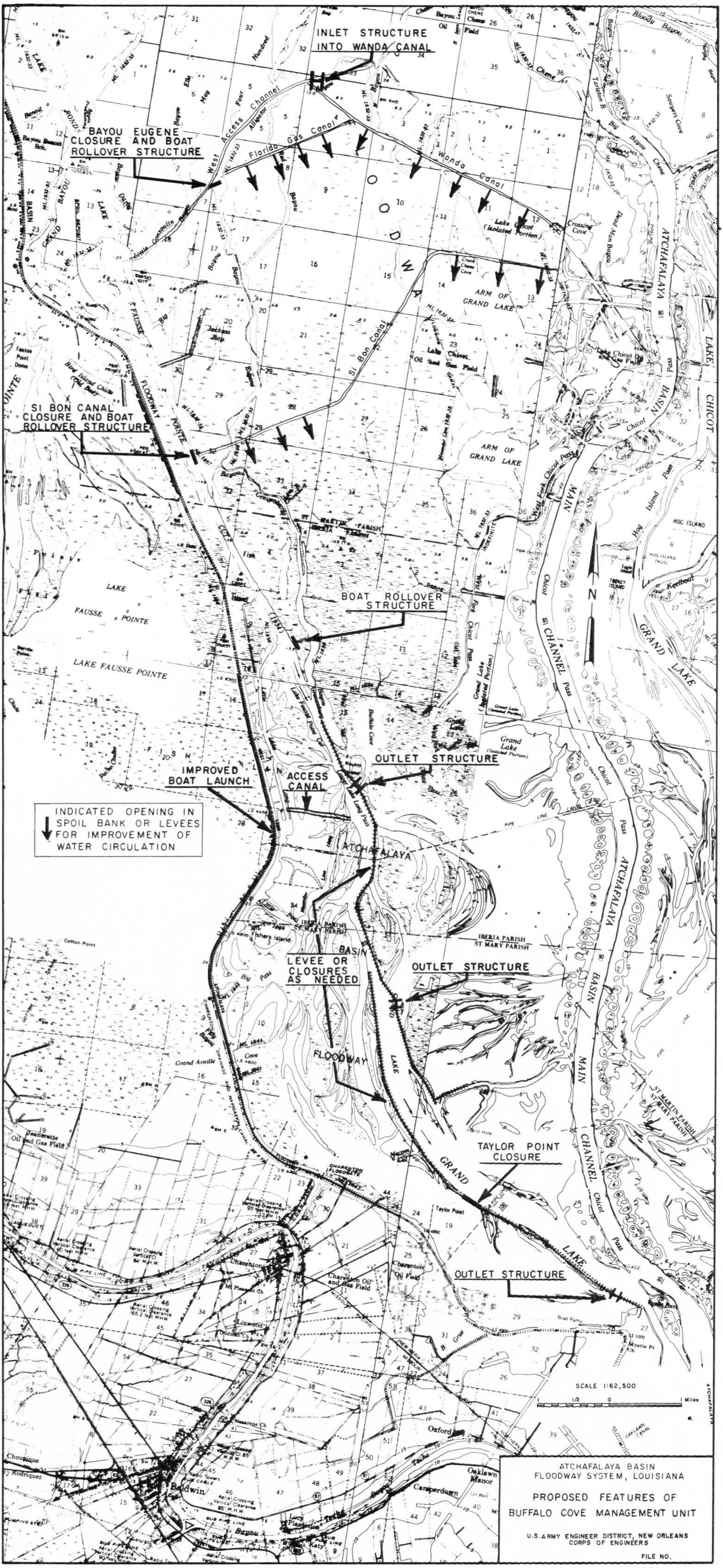

PROPOSED FEATURES (CONCEPTUAL)
(1,500 ACRES FEE)
BOAT RAMP
PRIMITIVE CAMPING AREAS
DEVELOPED CAMING AREAS (A,B,C)
PROJECT VISITOR'S CENTER
CANOE/BOAT SCENIC TRAIL
GREENBELTS 23,000 ACRES ALONG SELECTED SCENIC BAYOUS AND INTERIOR TOE OF BASIN PROTECTION LEVEES.
BOTTOMLAND HARDWOODS WILDLIFE MANAGEMENT AREA 30,000 ACRES
CYPRESS TUPELO NATURAL AREA 50,000 ACRES
ROOKERIES 500 ACRES
SPECIAL AND UNIQUE AREA 200 ACRE FEE
CRAWFISHING AREAS ALONG PORTIONS OF LEVEE
N
MANSURA HILLS
Old River Control Structures
Outflow Channel
RED RIVER
MISSISSIPPI
LOUISIANA
Old River Lock
WEST ATCHAFALAYA FLOODWAY
MORGANZA FLOODWAY
Morganza Control Structure
MISSISSIPPI RIVER
Port Allen
Old Atchafalaya River
Henderson
Lafayette
Catahoula
Saint Martinville
LAKE DAUTERIVE
New Iberia
Atchafalaya River Main Channel
Bayou Sorrel Lock
Plaquemine
Donaldsonville
Pierre Port
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
LAKE VERRET
Backwater Area
LAC DES ALLEMANDS
Thibodaux
LAKE PALOURDE
Morgan City
Bayou Boeuf Lock
Houma
Avoca Island Levee
VERMILLION BAY
WEST COTE BLANCHE BAY
EAST COTE BLANCHE BAY
MARSH ISLAND
ATCHAFALAYA BAY
ATCHAFALAYA DELTA WILDLIFE MANAGEMENT AREA
SCALE OF MILES
5 0 5
GULF OF MEXICO
Chene, Boeuf, and Black Navigation Channel
Pointe au Fer Reef
Four League Bay
Terrebonne Parish Marshes
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
PROPOSED RECREATIONAL DEVELOPMENT PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE B-12



ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA

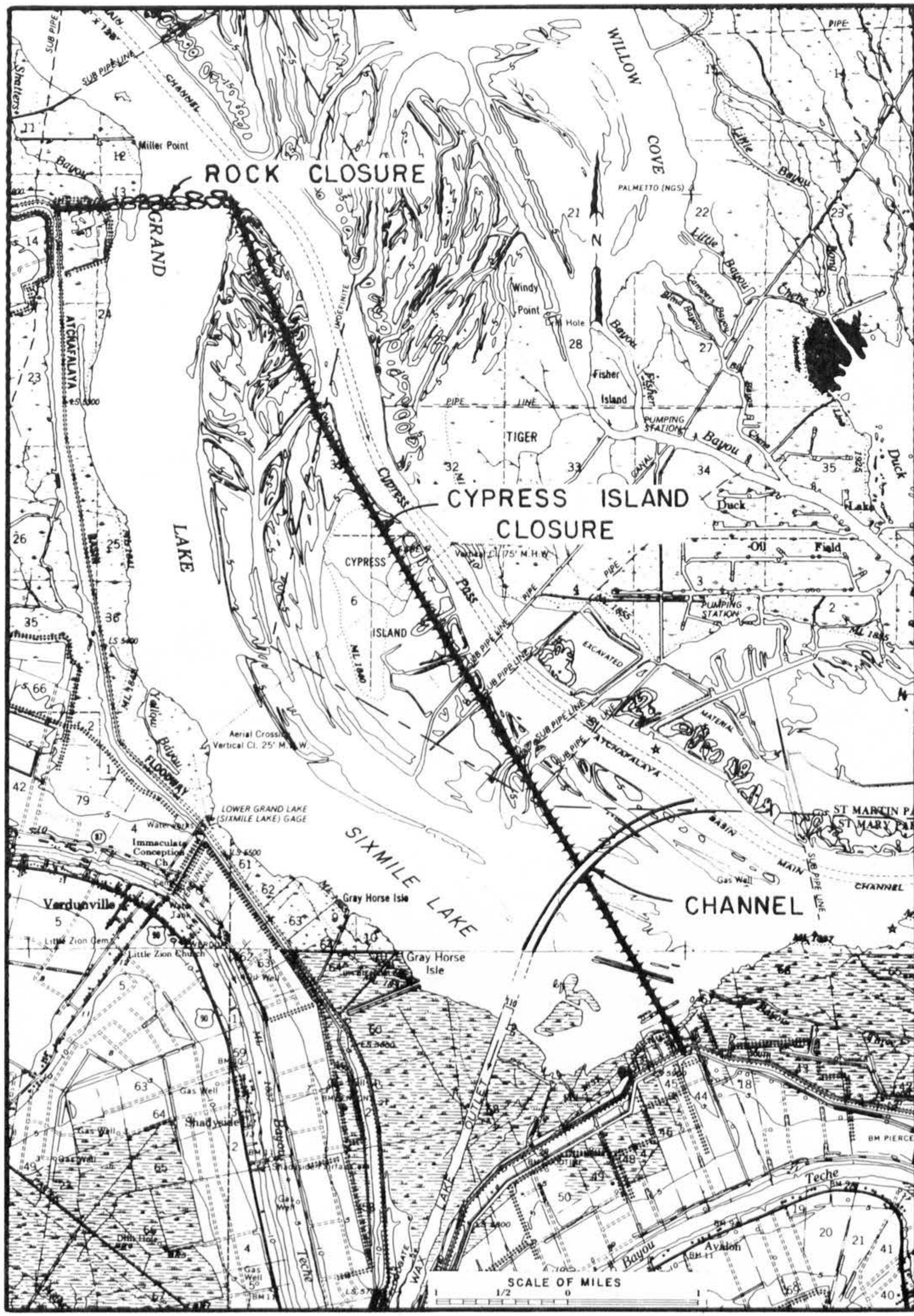
PROPOSED FEATURES OF BUFFALO COVE MANAGEMENT UNIT

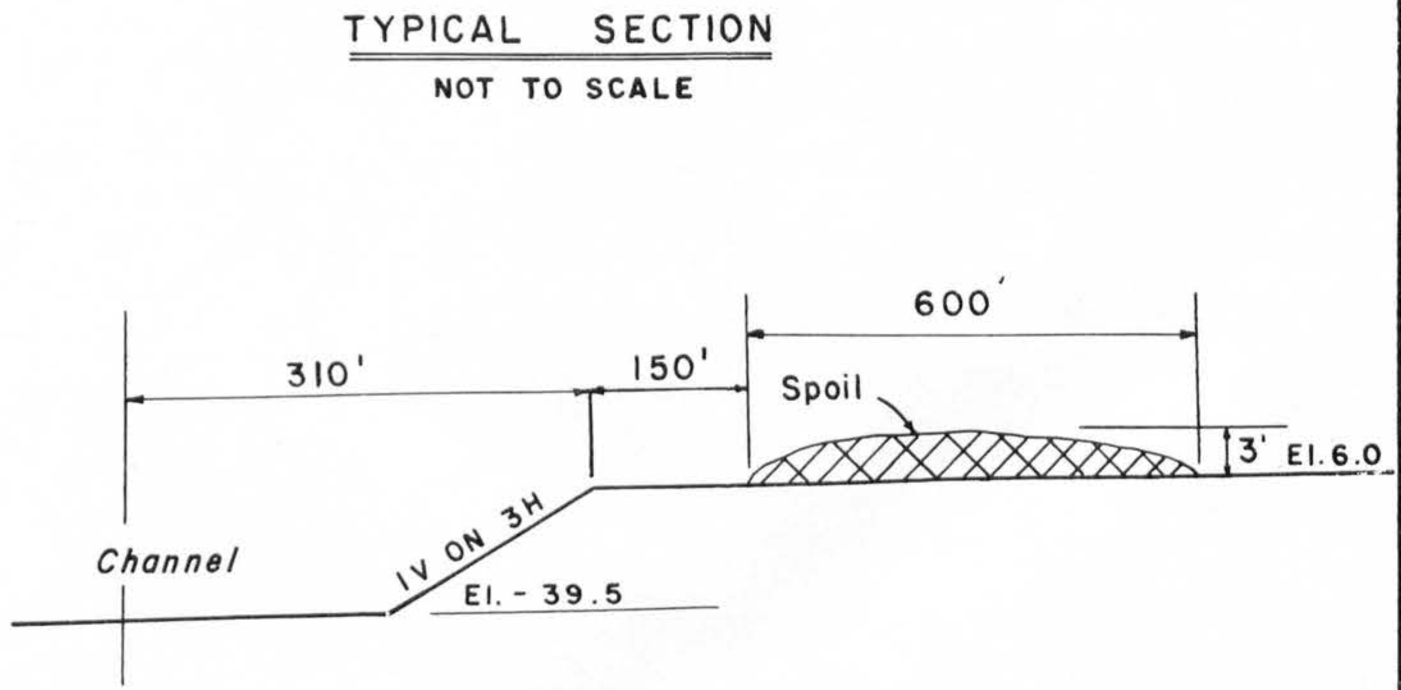
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS

FILE NO.

PLATE B-13

PLATE B-13



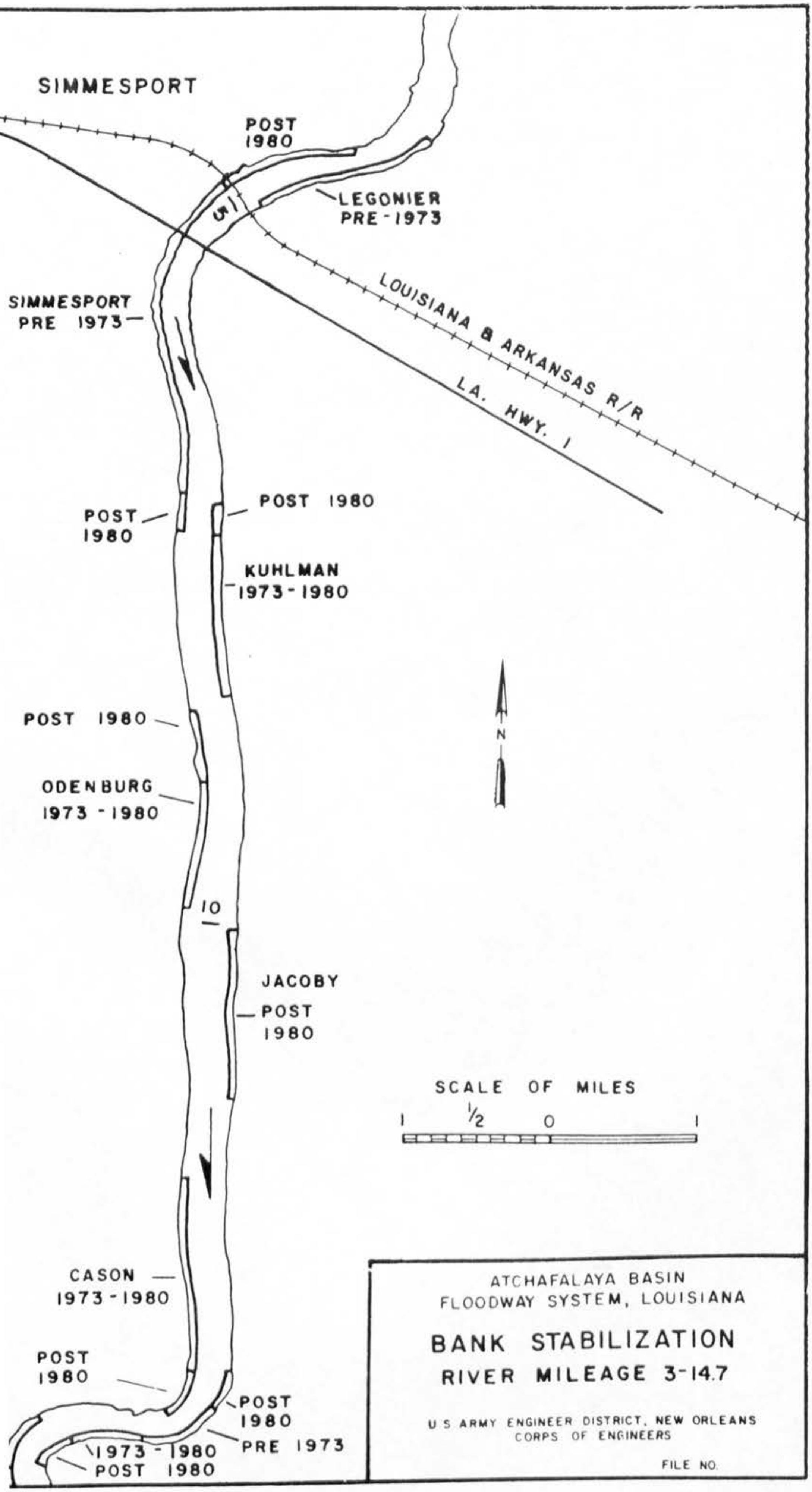


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

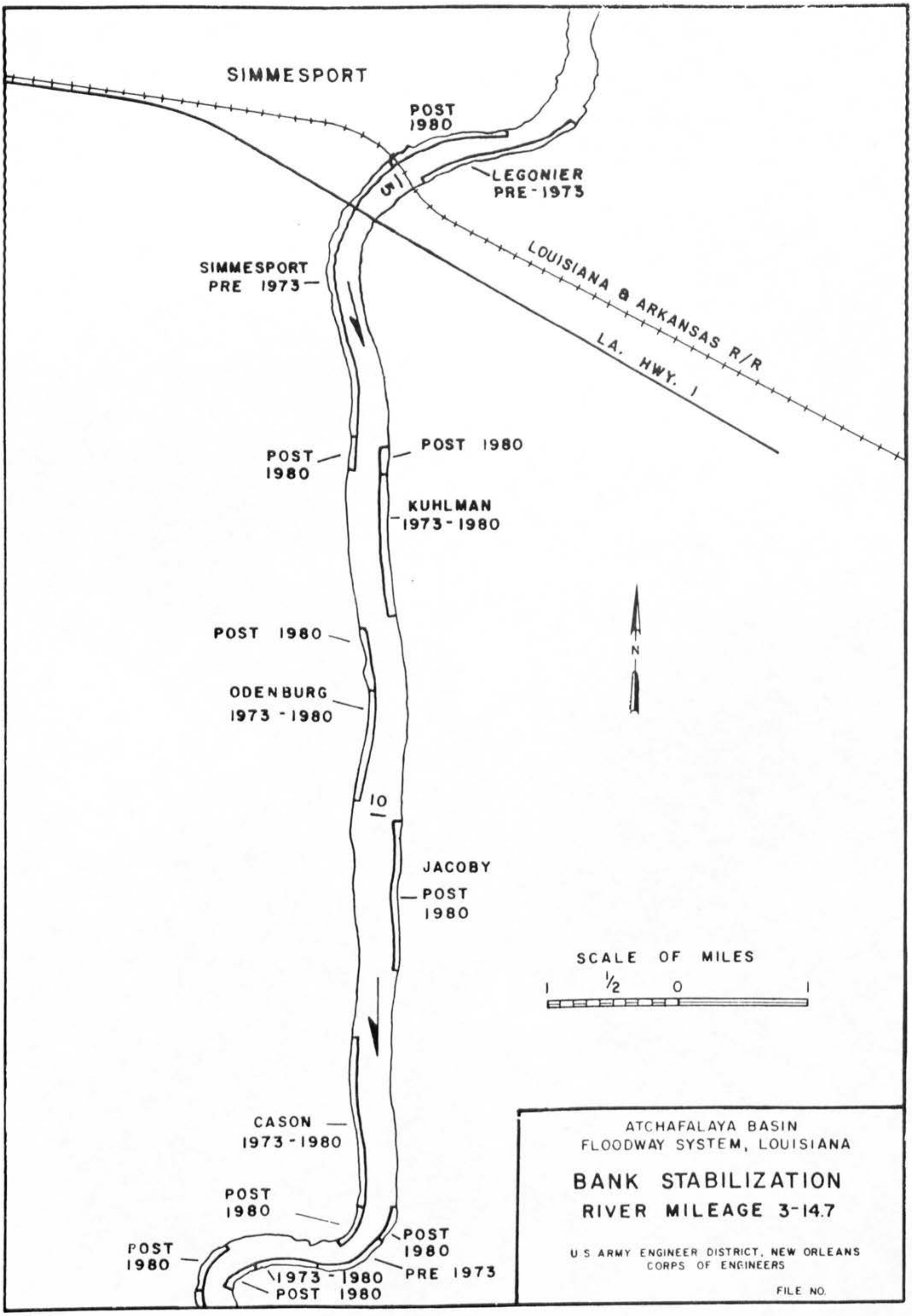
INCREASED SEDIMENT THROUGH WAX LAKE OUTLET

U.S. ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.



SIMMESPORT
POST 1980
LEGONIER PRE-1973
5
LOUISIANA & ARKANSAS R/R
LA. HWY. 1
SIMMESPORT PRE 1973
POST 1980
POST 1980
KUHLMAN 1973-1980
N
POST 1980
ODENBURG 1973-1980
10
JACOBY POST 1980
SCALE OF MILES
1 1/2 0 1
CASON 1973-1980
POST 1980
POST 1980
PRE 1973
1973-1980
POST 1980
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 3-14.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BANK STABILIZATION
RIVER MILEAGE 3-14.7

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
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FILE NO.

PLATE B-15

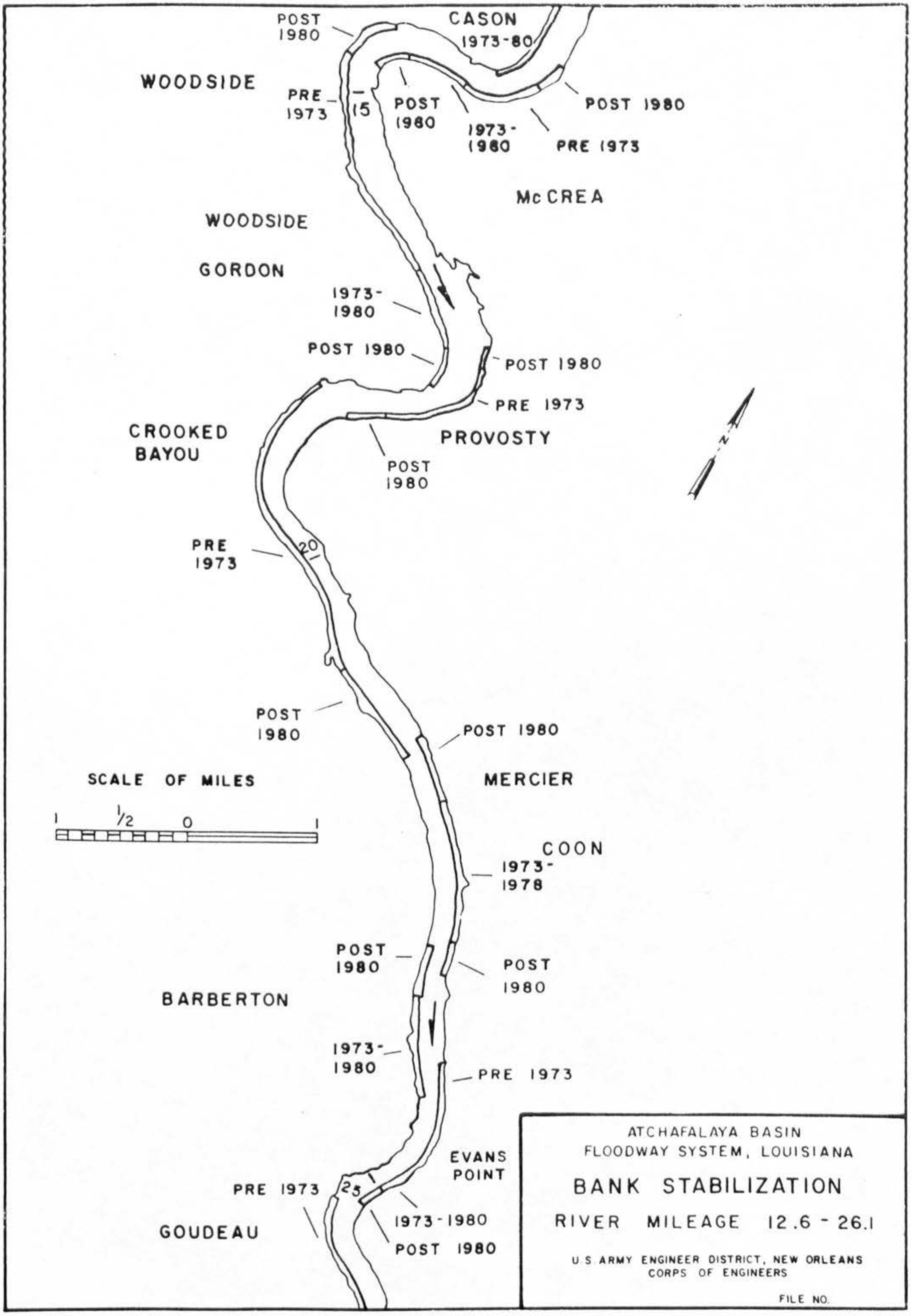
CASON
1973-80
POST
1980
WOODSIDE
PRE
1973
15
POST
1980
1973-
1980
POST 1980
PRE 1973
McCREA
WOODSIDE
GORDON
1973-
1980
POST 1980
POST 1980
PRE 1973
CROOKED
BAYOU
PROVOSTY
POST
1980
N
PRE
1973
20
POST
1980
POST 1980
MERCIER
SCALE OF MILES
1
1/2
0
1
COON
1973-
1978
POST
1980
POST
1980
BARBERTON
1973-
1980
PRE 1973
EVANS
POINT
PRE 1973
25
1973-1980
GOUDEAU
POST 1980
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 12.6 - 26.1
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-16

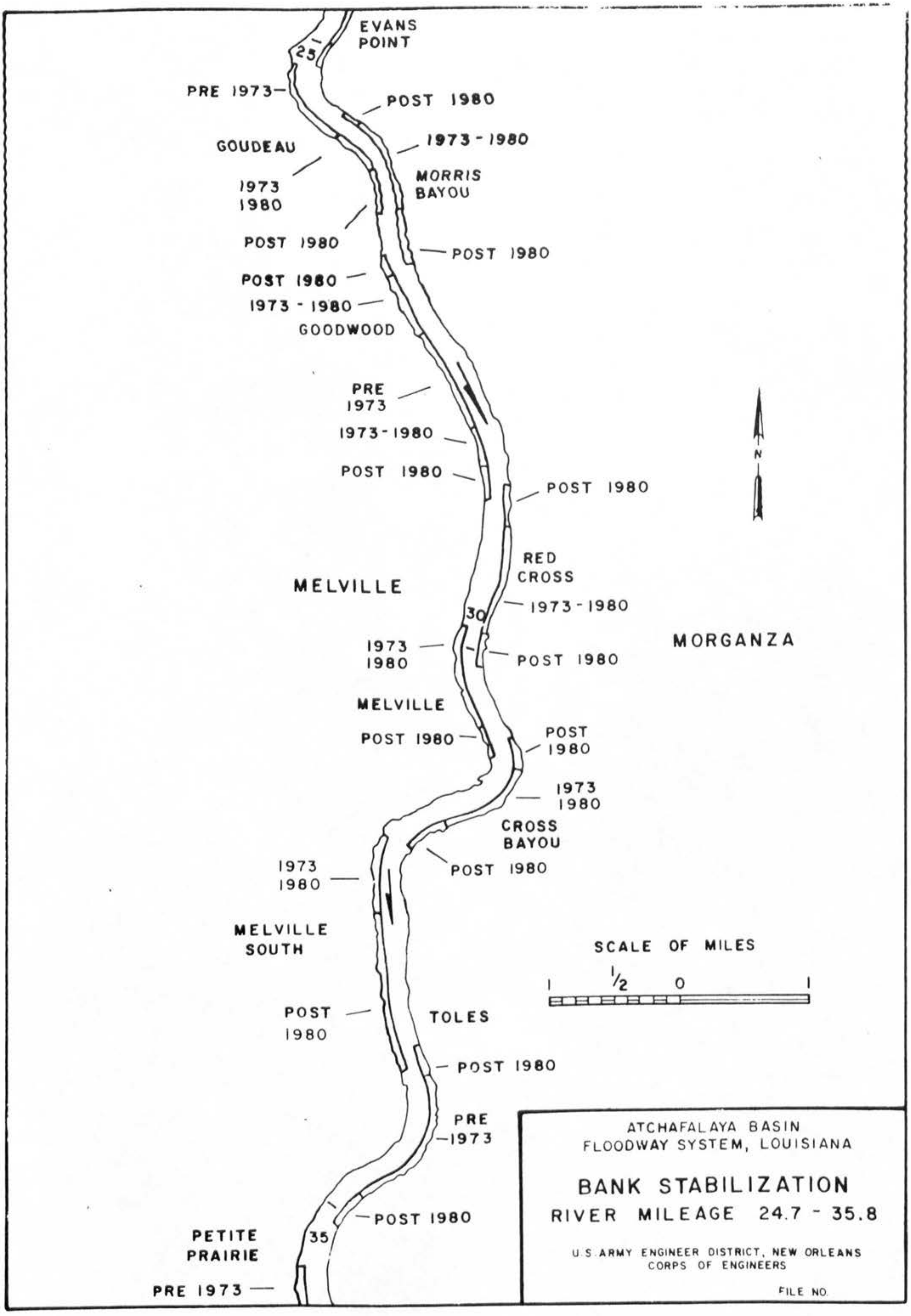
EVANS POINT
25
PRE 1973
POST 1980
GOUDEAU
1973 - 1980
MORRIS BAYOU
1973
1980
POST 1980
POST 1980
POST 1980
1973 - 1980
GOODWOOD
PRE 1973
1973-1980
POST 1980
POST 1980
N
RED CROSS
MELVILLE
30
1973 - 1980
MORGANZA
1973
1980
POST 1980
MELVILLE
POST 1980
POST 1980
1973
1980
CROSS BAYOU
1973
1980
POST 1980
MELVILLE SOUTH
SCALE OF MILES
1 1/2 0 1
POST 1980
TOLES
POST 1980
PRE 1973
POST 1980
PETITE PRAIRIE
35
PRE 1973
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 24.7 - 35.8
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-17

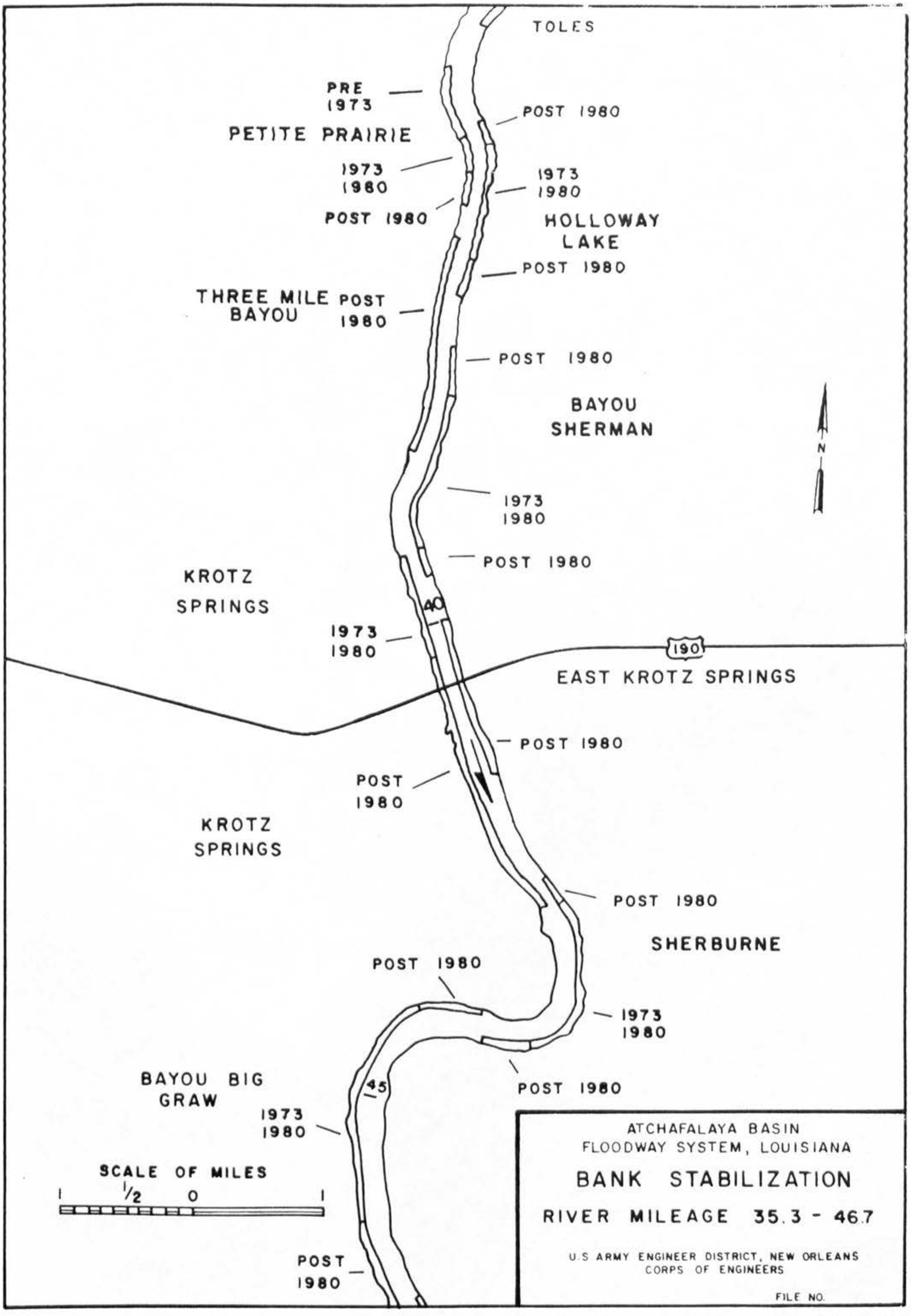
TOLES
PRE 1973
PETITE PRAIRIE
POST 1980
1973 1980
1973 1980
POST 1980
HOLLOWAY LAKE
POST 1980
THREE MILE BAYOU
POST 1980
POST 1980
BAYOU SHERMAN
N
1973 1980
POST 1980
KROTZ SPRINGS
40
1973 1980
190
EAST KROTZ SPRINGS
POST 1980
POST 1980
KROTZ SPRINGS
POST 1980
SHERBURNE
POST 1980
1973 1980
POST 1980
BAYOU BIG GRAW
45
1973 1980
SCALE OF MILES
1 1/2 0 1
POST 1980
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 35.3 - 46.7
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-18

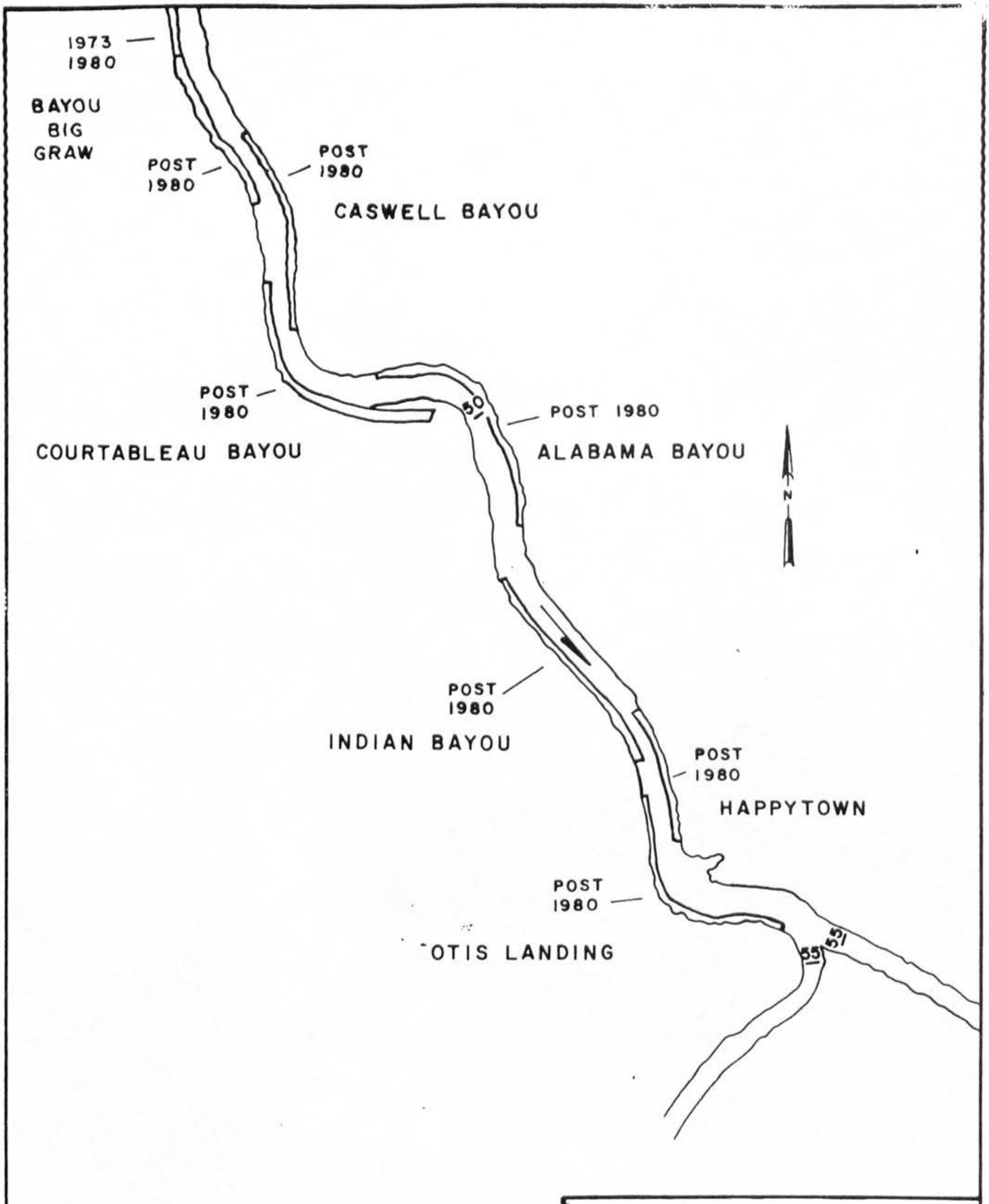
1973
1980
BAYOU BIG GRAW
POST 1980
POST 1980
CASWELL BAYOU
POST 1980
50
POST 1980
COURTABLEAU BAYOU
ALABAMA BAYOU
N
POST 1980
INDIAN BAYOU
POST 1980
HAPPYTOWN
POST 1980
OTIS LANDING
55
55
SCALE OF MILES
1 1/2 0 1
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BANK STABILIZATION
RIVER MILEAGE 46.2 - 55
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO

PLATE B-19

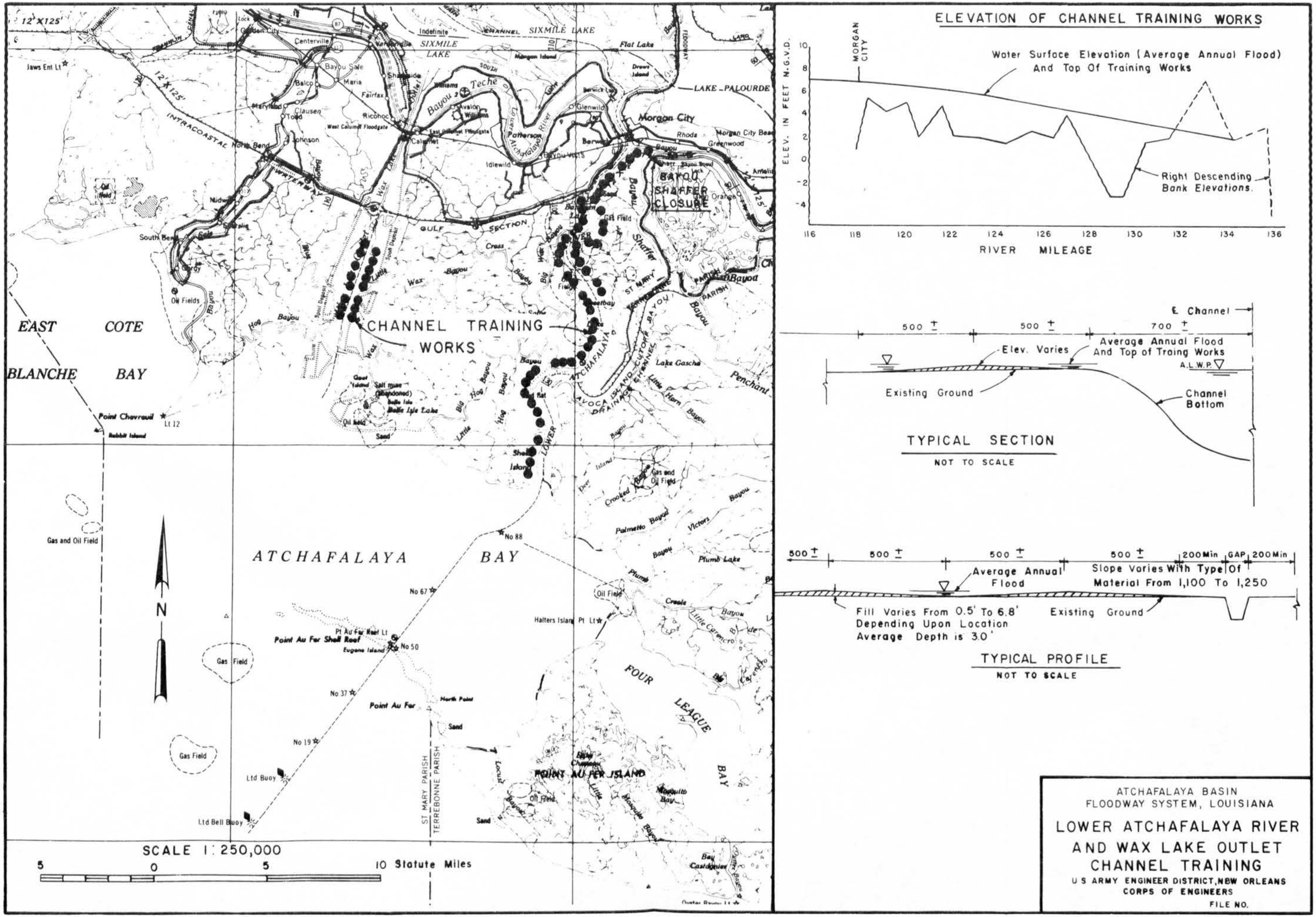
ELEVATION OF CHANNEL TRAINING WORKS
ELEV. IN FEET N.G.V.D.
MORGAN CITY
Water Surface Elevation (Average Annual Flood) And Top Of Training Works
Right Descending Bank Elevations
RIVER MILEAGE
℄ Channel
500 ±
500 ±
700 ±
Elev. Varies
Average Annual Flood And Top of Traing Works
A.L.W.P.
Existing Ground
Channel Bottom
TYPICAL SECTION
NOT TO SCALE
500 ±
500 ±
500 ±
500 ±
200 Min
GAP
200 Min
Average Annual Flood
Slope Varies With Type Of Material From 1,100 To 1,250
Fill Varies From 0.5' To 6.8' Depending Upon Location Average Depth is 3.0'
Existing Ground
TYPICAL PROFILE
NOT TO SCALE
CHANNEL TRAINING WORKS
BAYOU SHAFFER CLOSURE
EAST COTE BLANCHE BAY
ATCHAFALAYA BAY
FOUR LEAGUE BAY
INTRACOASTAL WATERWAY
GULF SECTION
Morgan City
Centerville
Patterson
Berwick
LAKE PALOURDE
SIXMILE LAKE
Point Au Fer
POINT AU FER ISLAND
Point Chevreuil
ST MARY PARISH
TERREBONNE PARISH
N
SCALE 1:250,000
5 0 5 10 Statute Miles
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
LOWER ATCHAFALAYA RIVER AND WAX LAKE OUTLET CHANNEL TRAINING
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE B-20

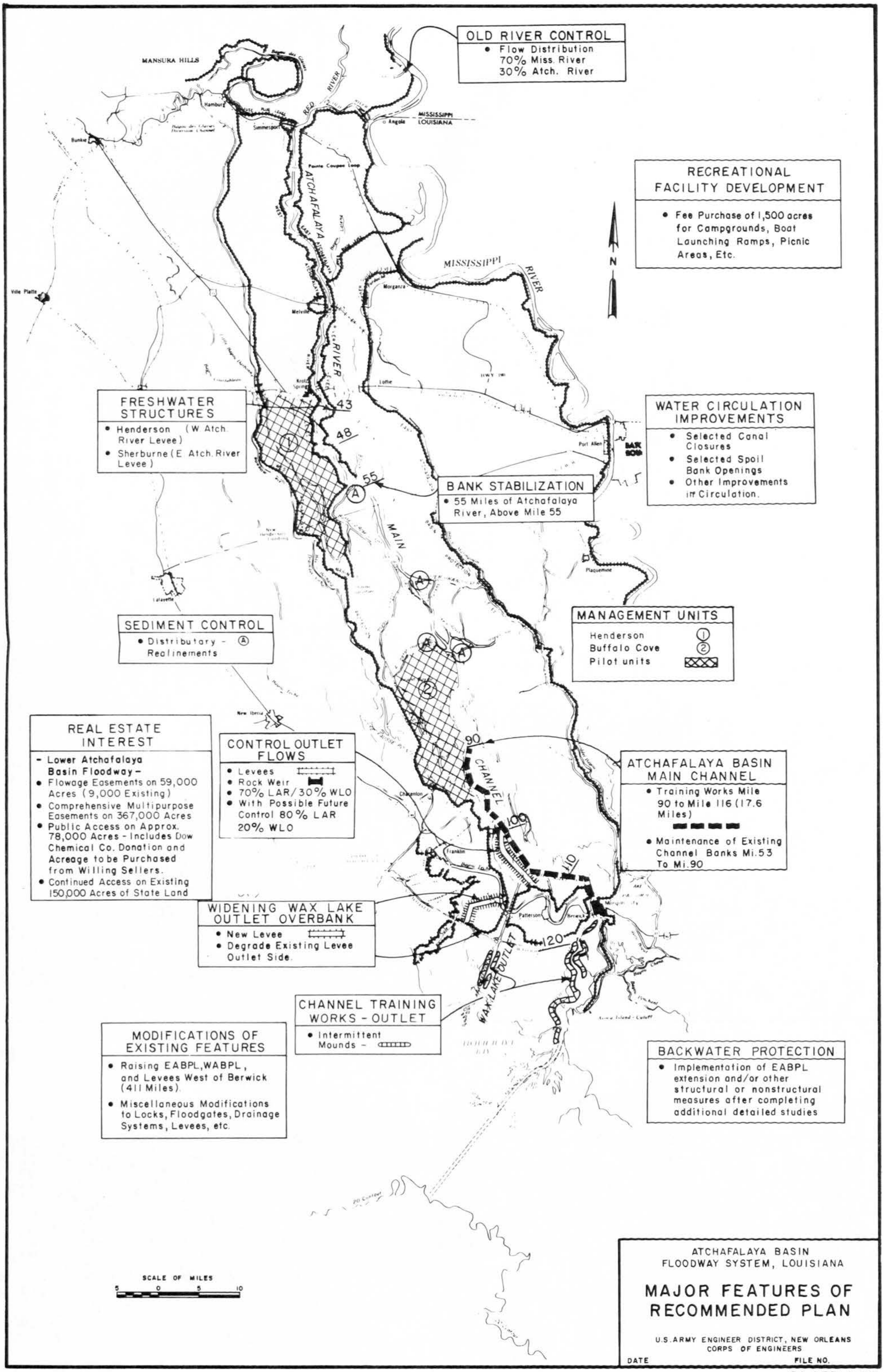
OLD RIVER CONTROL
• Flow Distribution 70% Miss. River 30% Atch. River
RECREATIONAL FACILITY DEVELOPMENT
• Fee Purchase of 1,500 acres for Campgrounds, Boat Launching Ramps, Picnic Areas, Etc.
FRESHWATER STRUCTURES
• Henderson (W. Atch. River Levee)
• Sherburne (E. Atch. River Levee)
WATER CIRCULATION IMPROVEMENTS
• Selected Canal Closures
• Selected Spoil Bank Openings
• Other Improvements in Circulation.
BANK STABILIZATION
• 55 Miles of Atchafalaya River, Above Mile 55
MANAGEMENT UNITS
Henderson 1
Buffalo Cove 2
Pilot units
SEDIMENT CONTROL
• Distributary - A Realinements
REAL ESTATE INTEREST
- Lower Atchafalaya Basin Floodway -
• Flowage Easements on 59,000 Acres (9,000 Existing)
• Comprehensive Multipurpose Easements on 367,000 Acres
• Public Access on Approx. 78,000 Acres - Includes Dow Chemical Co. Donation and Acreage to be Purchased from Willing Sellers.
• Continued Access on Existing 150,000 Acres of State Land
CONTROL OUTLET FLOWS
• Levees
• Rock Weir
• 70% LAR/30% WLO
• With Possible Future Control 80% LAR 20% WLO
ATCHAFALAYA BASIN MAIN CHANNEL
• Training Works Mile 90 to Mile 116 (17.6 Miles)
• Maintenance of Existing Channel Banks Mi.53 To Mi.90
WIDENING WAX LAKE OUTLET OVERBANK
• New Levee
• Degrade Existing Levee Outlet Side.
CHANNEL TRAINING WORKS - OUTLET
• Intermittent Mounds -
MODIFICATIONS OF EXISTING FEATURES
• Raising EABPL, WABPL, and Levees West of Berwick (411 Miles).
• Miscellaneous Modifications to Locks, Floodgates, Drainage Systems, Levees, etc.
BACKWATER PROTECTION
• Implementation of EABPL extension and/or other structural or nonstructural measures after completing additional detailed studies
MANSURA HILLS
Hamburg
Simmesport
Bunkie
RED RIVER
MISSISSIPPI
LOUISIANA
Angola
Pointe Coupee Loop
ATCHAFALAYA
RIVER
MISSISSIPPI RIVER
N
Ville Platte
Melville
Morganza
Krotz Springs
Lottie
Port Allen
Plaquemine
Lafayette
New Iberia
Charenton
Franklin
Patterson
Berwick
Morgan City
MAIN CHANNEL
WAX LAKE OUTLET
43
48
55
90
100
110
120
SCALE OF MILES
5 0 5 10
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
MAJOR FEATURES OF RECOMMENDED PLAN
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
DATE
FILE NO.

PLATE B-21

APPENDIX C

ENGINEERING INVESTIGATIONS

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LIST OF PLATES (CONTINUED)

LIST OF PLATES (CONTINUED)

LIST OF PLATES (CONTINUED)

LIST OF PLATES (CONTINUED)

Appendix C

ENGINEERING INVESTIGATIONS

C.0.1. The scope of the investigations included in this report is considered adequate to compare various alternatives and to be used as a basis for further design. An historic description of the basin and a review of the present status of the project are contained in Appendix A. The discussions in the following sections offer details that explain the engineering investigations. Geographic locations referenced in this report can be found on Plate 1 of the main report.

Section 1 - EVALUATION PROCEDURE

GENERAL

C.1.1 Hydraulic and hydrologic investigations for the Atchafalaya Basin Study developed data to specifically address flood control in the basin, while other data were developed to address environmental concerns for a given alternative. The following paragraphs describe each category of information, how it was developed, and why it was required.

CHANNEL DEVELOPMENT CURVES

C.1.2. The connection between the Atchafalaya River and the Mississippi River was formed in the sixteenth century when a migrating meander of the Mississippi River intercepted the course of the Red River. In 1831, Captain Shreve cut off the meander to shortern the distance of the Mississippi River for improved navigation. Removal of the 20-mile-long driftwood raft in the Atchafalaya River in 1855 resulted in improved navigation in the Atchafalaya. As a consequence of siltation induced by the cut off and removal of the raft, the Red River altered its course to flow directly into the Atchafalaya River. Therefore, the Atchafalaya River gradually claimed increasing shares of the flows from the Mississippi and Red Rivers. The gradual increase of flow into the Atchafalaya River was accompanied by steady increases in cross-sectional area.

C.1.3. Cross-sectional area of the Atchafalaya River is measured in square feet (sf) below the 1963 reference flowline, which results in channel area below a fixed datum plane. The fixed datum plane was used to facilitate comparison of hydrographic surveys. The change in channel area for the fixed datum plane represents a change in the channel geometry and is not necessarily directly related to a change in the wetted area of the stream for a given basin discharge, since a change in channel area is accompanied by a change in the actual flowline.

C.1.4. Hydrographic surveys of the channel have been taken since the late 1800's. The areas for several cross sections spread over a few miles are averaged for each survey to give the average area for a reach. The areas for several reaches are averaged to give the average channel area for mile 0-54.8[1/] (leveed reaches), mile 54.8-65.4

[1/] All mileage is referenced to 1950 mileage unless otherwise noted.

(Whiskey Bay Pilot Channel), mile 65.4-100.8 (distributary reaches), mile 100.8-113.7 (lake area), mile 105.5-124.0 (Wax Lake Outlet), and mile 113.7-136.8 (Lower Atchafalaya River). The channel development curves for each section of the river are plotted as channel area versus the year of the survey (Plates C-1 through C-8).

C.1.5. Since the removal of the rafts in the Atchafalaya River, the cross-sectional area of the Atchafalaya River has continued to increase; the lakes in the lower part of the basin have filled with sediments; and the development of a main channel through the lakes has taken place. Dredging of the main channel from 1955 to 1968 was for the purpose of accelerating the development of this channel. Concurrent with the dredging program, closure of 22 distributaries was accomplished to confine a larger percent of the flow to the main channel which, in turn, accelerated the natural erosive action of the river to establish a larger main channel. As shown on Plates C-1 through C-8 the area of the river has progressed to approximately 118,000 sf from mile 0 to mile 54.8; to 92,000 sf from mile 54.8 to 65.4; to 80,000 sf from mile 65.4 to 100.8 and to 38,000 sf from mile 100.8 to 113.7. The area of the Lower Atchafalaya River (mile 113.7-136.8) had decreased to about 69,000 sf. This was primarily due to the loss of flow to the Wax Lake Outlet, which has increased its area to 38,000 sf.

C.1.6. Channel development curves give a graphic representation of channel geometry changes. The projections of the channel area shown on the curves were also used in the HEC-2 computer model, which is described later, to determine the effects channel development will have on average hydrographs in each management unit and on the project flood flowlines.

C.1.7. Projections of future channel development were based upon projections of changes in flow distribution and results of the computer model HEC-6, Scour and Deposition in Rivers and Reservoirs.

AREA - ELEVATION CURVES

C.1.8. The Atchafalaya Basin, as a riverine swamp, has been subject to yearly overflows of the Atchafalaya River. Along with the vast quantities of water overflowing the banks of the river, there have been equally large quantities of sediments. The lower basin was once characterized by the open bodies of water of Grand and Sixmile Lakes, but the sediments of the Atchafalaya have now filled these lakes. The overbank marsh areas have also received large quantities of sediments, causing some to become dry ground for most of the year. This process of a river overflowing its banks and depositing sediments in the adjacent areas is a natural process of a young developing river such as the Atchafalaya. Each year as the river conveys the springs floods to the gulf, it will overflow its banks and continue to deposit

sediments in the overbank areas. Deposition of these sediments deprives the floodway of some of the overbank area that should convey about two-thirds of the project flood.

C.1.9. Hydrographic surveys have been taken regularly since the late 1800's on the 30 cross-basin ranges located in the floodway. These surveys are used to monitor deposition rates. Five-foot contour lines were drawn from the 1974 survey to establish present conditions. From these contours the area-elevation curves were drawn to represent the area of land below a given elevation (Plates C-9 through C-23).

C.1.10. Future contour lines and area-elevation curves for the no-action alternative were drawn, based on past deposition rates, expected flowline changes, and changes in the distribution of flow within the basin. Area-elevation curves for various alternatives were drawn to illustrate what effect each alternative would have on the overbank deposition.

C.1.11. Area-elevation curves were drawn for each of the management unit areas (Figure C-1-1) and for the backwater area east of Morgan City. The latter area was divided into four subareas (Plate C-48) for which the present curves were assumed to be applicable to future conditions, since the region is not subject to sediment deposition.

C.1.12. The area-elevation curves were divided into habitat types to evaluate land-use projection. This division of the curves is discussed in Appendix G. The area-elevation curves also represent the overbank deposition that was used in the HEC-2 computer program to determine deposition effects on average hydrographs and project flowlines.

STAGE - DISCHARGE RELATIONSHIPS

C.1.13. Discharge observations have been made regularly on the Atchafalaya River at Simmesport, Louisiana, since 1928. Except for local rainfall or during operation of the Morganza Floodway or West Atchafalaya Floodway, the Simmesport discharge represents the total flow in the Atchafalaya Basin Floodway. Annual sediment and discharge values for Simmesport are presented in Appendix A. While discharge measurements are made in the Lower Atchafalaya River at Morgan City and Wax Lake Outlet at Calumet, these are not rated stations and were only used to define the distribution of flow at the outlets. Water and sediment discharge measurements were also made in the east and west access channels and east and west freshwater distribution channels to identify the water and sediment being conveyed from the main channel. Additional discharge measurements are made at discharge ranges throughout the floodway during distribution of flow measurements (Plate C-24). There have been 18 of these surveys since

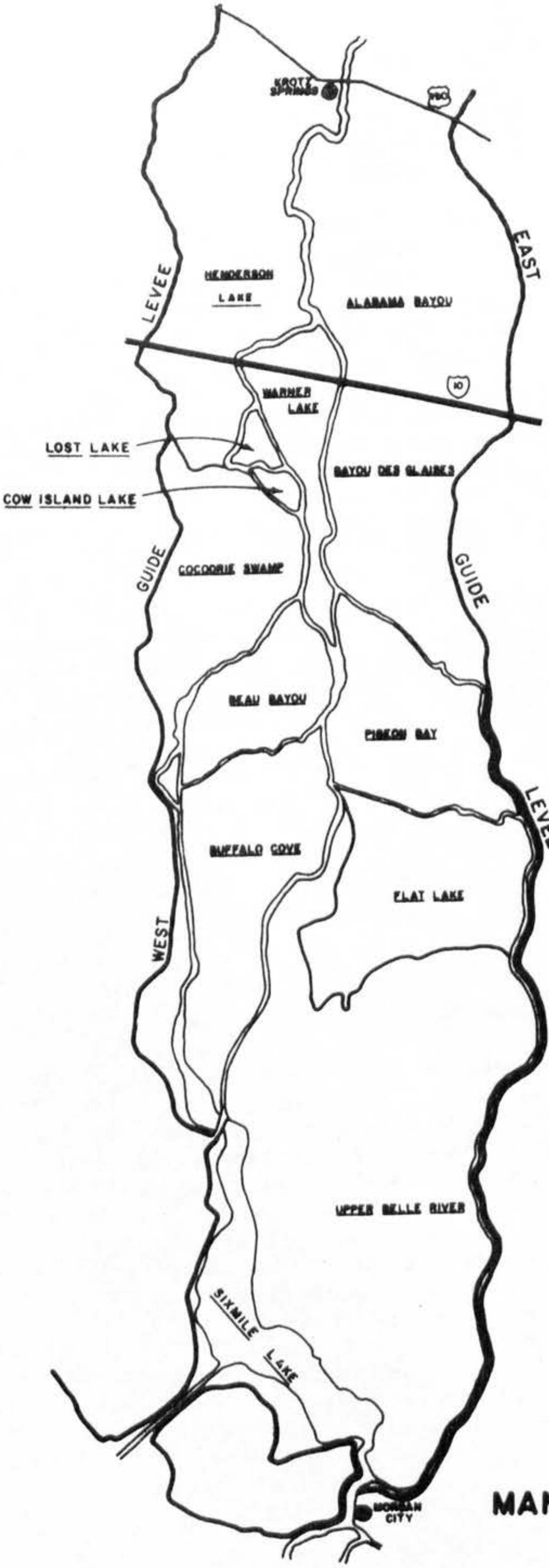

FIGURE C-1-1

MANAGEMENT UNITS

1955, and they were used to identify the distribution of flow shown on Plate C-25.

C.1.14. Stage indicators are located throughout the floodway. These gaging stations have records that have been maintained from 4 to 100 years.

C.1.15. Stage discharge relationships were developed for stages at each of the gaging stations and discharges at Simmesport. These relationships became the base for average stage hydrographs, with or without management units. The relationships were further supplemented by data obtained from the Mississippi Basin Model (MBM) at Waterways Experiment Station (WES), which will be discussed later. Projections of future stage discharge relationships were based on the HEC-2 and HEC-6 computer runs, discussed in subsequent paragraphs.

MODEL STUDIES

C.1.16. MBM. The MBM is a fixed bed model located in Jackson, Mississippi, and operated by WES in Vicksburg, Mississippi. The model has a 1:100 vertical scale and 1:2000 horizontal scale. The portion of the model used in this study extends from Simmesport to Eugene Island in the Atchafalaya Bay and includes the West Atchafalaya Floodway and the Morganza Floodway. The discharge enters the model at Simmesport and the West Atchafalaya and Morganza Floodways when appropriate. Elevations at Eugene Island are controlled by an overflow weir. The model is capable of simulating steady-state discharges and discharge hydrographs. The model has been molded to 1973-1974 survey conditions and calibrated to the 1973 hydrograph.

C.1.17. Gages were placed in the model at prototype gage locations and in the center of each management unit area (Plate C-26). The gages in the center of the units are the basis for stage relationships between the center of a unit and the river at the unit's inlet. Data obtained from hydrograph runs and steady flow runs were used to develop these relationships. The loop effect (stages for a given discharge are higher on the falling side of the hydrograph than on the rising side), which is prevalent in this area, has been averaged out.

C.1.18. Data were obtained from model runs using the average hydrograph, shifted average hydrograph, and constant discharges of 50,000, 100,000, 200,000, 350,000, 425,000, 600,000, and 800,000 cubic feet per second (cfs). Additional tests using hydrographs and steady discharges were run with Wax Lake Outlet closed, with channel training works in place, and with the Buffalo Cove management unit in place. In addition to stage data, information was obtained from these runs of flow patterns in the Atchafalaya Bay. The results of all tests are presented in MBM Report 31-8, "Effects of Closing Wax Lake

Outlet and Constructing Management Unit and Channel Training Levees in the Atchafalaya Basin," November 1980.

C.1.19. HEC-2. Flowlines (water surface profiles) for various flows, including the project flood, were computed using HEC-2, "Water Surface Profiles," a computer program developed by the Hydrologic Engineering Center (HEC) in Davis, California. The program computes backwater profiles by the standard step method.

C.1.20. The channel cross sections used in the HEC-2 model were established from 1973 element surveys located no more than 1.5 miles apart. The overbank sections within the floodway were established from sedimentation ranges dated 1966-1973. Because of the accretion occurring in the lower basin, aerial reconnaissance trips were made and overbank sections were modified, as necessary, to accommodate changes in features, such as, filling of lakes and closure of distributary channels.

C.1.21. Calibration of the analytical model was accomplished using observed flowlines from stage and discharge records obtained during the 1973 flood. To reduce possible errors, which could be generated by storage and momentum effects, periods of relatively constant stage and discharge ranging from 5 to 10 days were chosen for flowline calibration. Details of the calibration, including observed and computed flowlines, can be found in "MR&T Project Flood Flowline Review Report," dated December 1976, revised September 1977. Projected changes in channel development and overbank deposition were incorporated into the model to develop flowlines for various alternatives. Flowlines for discharges of 50,000, 100,000, 250,000, 350,000, and 450,000 cfs were computed for the alternative plans. Comparisons of the flowline conditions were used to modify the stage-discharge relationships for each of the management unit areas to obtain the future rating curves of the units.

C.1.22. Project flood flowlines for each alternative plan were computed with the HEC-2 model. This will be discussed in detail subsequently in this report.

C.1.23. HEC-6. Projections of future channel development were supplemented by runs of the computer program HEC-6, "Scour and Deposition in Rivers and Reservoirs." The program is a one-dimensional steady flow model designed to analyze scour and deposition by modeling the interaction between the water-sediment mixture, sediment material forming the stream's boundary, and the hydraulics of flow. The model cannot simulate the development of meanders or specify a lateral distribution of sediment load across a cross section.

C.1.24. A special version of HEC-6 was used in this study. The "strip model" enabled the basin to be divided into six strips, each containing portions of the basin with similar hydraulic and sediment

carrying characteristics. Strip 1 consisted of Lake Long, Lake Fausse Pointe Cut, and Grand Lake, and contained characteristics (Manning's "n", scour, and deposition capabilities), which would be experienced by a channel. Strip 2 modeled the overbank area west of the main channel and contained characteristics of an overbank flow regime. The main channel throughout the floodway was modeled in strip 3. Because of its large transport capacity during high discharges, Grand Lake east of the main channel was modeled with channel characteristics during high flows in strip 4. Strip 5 contained overbank characteristics for the overbank area east of the main channel. Upper Grand River and the alternate route of the intracoastal waterway were modeled with channel characteristics in strip 6. In parts of the basin where the area represented by a strip merged with the main channel, such as, Lower Atchafalaya River at Morgan City, the strip was reduced to a width of 1 foot and therefore, became ineffective.

C.1.25. The geometry used in the HEC-6 model is basically the same geometry developed for the HEC-2 model. A description of its derivation is contained in the previous section of this appendix. Modification of the HEC-2 data consisted of elimination of some cross sections so that they were located at about 1-mile intervals. This reduction in the number of cross sections permitted a single HEC-6 model from mile 0 on the Atchafalaya River to mile 146 on the Lower Atchafalaya River. The program did not model Wax Lake Outlet, Morganza Floodway, or the West Atchafalaya Floodway directy, but did account for them by the proper introduction or reduction of flow at their locations. The inflowing sediment rating curve used in the program was the average rating curve at Simmesport for the period 1971-1975. Bed gradations were derived from sampling of the river bed at 5-mile intervals in 1975.

C.1.26. Calibration of the model was made to observed water surface elevations, observed distribution of flow, and observed sediment loads at Morgan City. The proper distribution of flow between strips was determined from observed distribution of flow in the basin and from observations of the MBM (both discussed previously).

C.1.27. Hydrographs used in simulation runs consisted of Simmesport discharge hydrographs modified to reflect a 30-percent latitude flow at Old River. Changes in the percent diverted through Wax Lake Outlet enabled the model to simulate the effects different outlet distributions would have on channel development.

C.1.28. Comparisons of channel development from the simulation runs were used as input to generating channel development curves. Since the HEC-6 program did not model silt and clay transport and is a one-dimensional model, it is not appropriate to use its results as definitive answers, but one can use HEC-6 as a tool to compare two alternatives.

AVERAGE HYDROGRAPHS

C.1.29. Without Management Units. The aquatic nature of the Atchafalaya Basin Floodway is measured by the extent and duration of normal overbank flooding. To describe this aquatic nature and determine the effects various alternatives would have on it, average hydrographs were developed. Since during the average year, neither Morganza nor the West Atchafalaya Floodways are operating, the Simmesport discharge represents the total flow in the Atchafalaya Basin Floodway. Development of the average discharge hydrograph for the Atchafalaya River at Simmesport was the key to describing average stage hydrographs, since, as discussed previously, the stages in all parts of the floodway were related to the Simmesport discharge.

C.1.30. Daily discharges have been computed for the latitude of flow below Old River since 1949. Thirty percent of the latitude discharge for the period 1949-1978, was used to compute the average hydrograph by averaging the discharge values for each day for all the years.

C.1.31. The total flow for the average annual hydrograph was equal to the average annual total flow for the 30 years, but the shape of the average hydrograph did not represent the general shape of an observed hydrograph. This is exemplified by the peak discharge of the average annual hydrograph about 100,000 cfs less than the average annual peak for the 30 years. The peak of the average hydrograph is less than the average annual peak because the peak of each year occurred over a large time frame and not on a common day. Use of this hydrograph would result in considerably lower peak stages throughout the floodway; therefore, the area of land inundated during the average hydrograph would be far less than that inundated during the average year.

C.1.32. To rectify this, the average annual shifted hydrograph was computed by shifting each hydrograph so that it would peak on 15 April (the day the average hydrograph peaked). Since the peak discharge in a year did occur up to 62 days from April 15, water-year hydrographs (October-September) were used for this computation. Those days pushed off one end of the hydrograh because of the shift were moved to the vacant days on the other side of the hydrograph. While this exchange of days did in some instances leave a discontinuity in a hydrograph, it was found to be of little significance because of its location in the hydrograph (during low flows when all values averaged are generally the same). After shifting each hydrograph, the discharge value for each day was averaged with the value for its corresponding day for each year. The result of this procedure was an average shifted hydrograph with its peak equal to the average annual peak, and with its total volume equal to the average annual total flow for the 30 years. As shown on Plate C-27, the average shifted hydrograph not only has a higher peak but has a steeper rise and fall than the average annual hydrograph, being more representative of a typical hydrograph.

C.1.33. From this average shifted hydrograph and the rating curves discussed previously, stage hydrographs were developed for each management unit area (Plate C-28 through C-36). These stage hydrographs were developed for existing conditions and for future conditions for various alternatives.

C.1.34. With Management Units in Place. It was necessary to develop stage hydrographs with management units (Figure C-1-1) in place in a different manner, since construction of the management units would change the hydrologic relationship of the overbank area to the main channel. Construction of management units consists of building a levee around the area up to an elevation equal to the average annual peak flowline. Inlets and outlets to the units were located to increase circulation through the units. In most instances, this called for the introduction of water to the unit at a higher level than existing conditions. For these reasons, the relationships of stage to Simmesport discharge had to be modified.

C.1.35. A computer program was used to develop the average stage hydrographs for conditions with management units in place. The program treated the management unit as a reservoir, and the level-pool flood routing method was utilized to route the inflow hydrograph through the unit. Input data to the program consisted of: the daily dicharges for the average shifted hydrograph; polynomial equations fitted to the stage-storage curve for the unit, stage-discharge curve at the inlet, and stage-discharge curve at the outlet; and the type and physical dimensions of the inlet and outlet of the unit.

C.1.36. The program begins its calculations by computing the stage at the inlet from the given Simmesport discharge and the equation for the stage-discharge relationship at the inlet. With this stage and the appropriate formula for the type of inlet structure, the flow into the unit was calculated. The inflow volume for the day was computed and added to the existing storage in the management unit. The stage associated with that storage volume was calculated by means of the equation fitted to the stage-storage curve, and the stage at the outlet is calculated by means of the equation at the outlet. The outflow was calculated by the appropriate formula, according to the type of structure at the outlet. The procedure was repeated for each day of the average hydrograph. Before printing the results, the program employed the method of moving averages to smooth out irregularities.

C.1.37. The program was capable of computing flow for the inlets and outlets, consisting of a broad-crested weir, box culvert, or an open channel. In all cases used for this study, except for Henderson and Alabama Bayous, the inlets and outlets were uncontrolled; therefore, water could flow in either direction. For example, flow out the inlet usually occurred during the falling side of the hydrograph when a small outlet was restricting flow and the stage in the management unit exceeded the stage in the river at the inlet.

C.1.38. Design of the inlets and outlets of the management units had the objective of duplicating the desired stage hydrograph for that management unit. Development of the desired hydrograph is discussed in Appendix G. Since the inlets and outlets of the units were uncontrolled weirs, except for Henderson and Alabama Bayous, the stage in the unit generally fluctuated with the stage of the river, but minor control of the stage could be achieved by varying the size of the inlet in both length and height.

C.1.39. The design of the Buffalo Cove inlets and outlets also gave consideration to minimizing the sediment entering the unit by minimizing the volume of water entering while still approximating the desired hydrograph. The result of the design (Plate C-37) is one or more inlets totaling 400 feet in length and a sill elevation of 7.0 National Geodetic Vertical Datum (NGVD).[2] The outlet weir has a 40-foot length and a sill elevation of 3.5. The model runs did indicate that this inlet and outlet could reduce the quantity of water and thus sediment diverted into the unit during the average hydrograph by about 50 percent; however, because of slower velocities through the unit, the trap efficiency was greater than for existing conditions. Because of the uncertainty of the trap efficiency of a unit, the ineffectiveness of a unit during higher than average hydrograph flows, and the uncertainty of how much of the confining levees will be initially constructed, the effects of the unit on sediment deposition was considered negligible.

C.1.40. The inlet structure for the Henderson management unit is the Courtableau Freshwater Diversion Structure, which is two 10-foot box culverts with invert elevations of 10 feet, located in the west Atchafalaya River levee at mile 48. This structure would be a gated culvert designed to pass up to 3,000 cfs. The exact location of the structure has not been determined at this time as several feasible sites exist. The hydrograph shown on Plate C-38 uses the structure located at mile 48 (Bayou Courtableau). If the structure were moved downstream about 5 miles to Indian Bayou, the hydrograph would be about 0.5 foot lower. If the structure were located at mile 45 at Big Bayou Graw, the hydrograph would be about 0.5 foot higher. The Henderson unit also received inflowing discharges from the existing Courtableau drainage structure in the West Atchafalaya Basin Protection Levee (WABPL). The average discharge hydrograph through the drainage structure was computed using observed discharges for 1968, 1969, and 1976. Other years were excluded because of dry periods occurring during times of high discharges in the Atchafalaya River, and very wet periods during times of low discharges in the Atchafalaya River.

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[2] Unless noted otherwise, all elevations are referenced to National Geodetic Vertical Datum of 1929 (NGVD).

C.1.41. A trial and error procedure was used to find the dimensions of the outlet weir that would result in a computed stage hydrograph that most closely approximates the desired hydrograph. This was performed for the unit with and without the Courtableau freshwater structure.

C.1.42. The result of the investigation was an outlet 20 feet long with a crest elevation of 9 feet for conditions with the freshwater structure. Plate C-38 shows the approximation of the desired hydrograph. For conditions without the freshwater structure, an outlet 40 feet long with a crest elevation of 9 feet was chosen. The closest approximation of the desired hydrograph for this case is shown on Plate C-39. It should be noted that only 3 years of record were used to compute the inflow hydrograph from the existing Courtableau drainage structure and that the inflow comes from a different watershed.

C.1.43. Since Buffalo Cove and Henderson were targeted as pilot management units, investigations of the remaining units were not as indepth. These investigations were made only to determine how close the desired hydrographs could be approximated without a detailed trial and error study of the sizes of the inlets and outlets. The closest approximations of the desired hydrographs for each unit are shown on Plates C-40 through C-47.

FREQUENCY CURVES - PARTIAL YEAR

C.1.44. As discussed in Appendix G, potential land clearing calculations were based on the number of acres flood free three out of five years during the growing season (1 June through 30 November). To define this elevation, stage frequency curves for the growing season were developed for each management unit area. Since stages in each unit area are related to the Simmesport discharge, the frequency analysis was run only on the Simmesport discharges.

C.1.45. The highest discharge for each calendar year during the period 1 June through 30 November was used for the analysis. Since the study period occurs during the low part of the hydrograph, 1 June was usually the day the highest discharge occurred. A frequency analysis was run on these discharges using the "Flood Flow Frequency Analysis" computer program. From the results of this program and from the stage-discharge relationships, the stage-frequency curve for each unit was drawn.

C.1.46. For conditions with the management units in place, the frequency curves were computed by comparing the 1 June stage, both with and without management unit conditions. This difference in stage was the extent the frequency curve without the management unit was

with the management unit. The date of 1 June was selected because this was usually the day of the discharge used to compute the original frequency curve.

C.1.47. Since the stage with a 40-percent exceedance frequency was the only point used from these frequency curves, the curves are not reproduced in this report, but the 40-percent stages are shown in Table C-1-1. The stages with a 40-percent exceedance frequency for Bayou Boeuf at Amelia are 2.6 for present conditions, 4.1 for future without the Avoca Island levee extension, and 2.3 for conditions with the levee extension. The respective stages for Pierre Pass at Pierre Part are 2.8, 4.2, and 2.5.

TABLE C-1-1

40 PERCENT EXCEEDANCE FREQUENCY STAGES - 1 JUNE THROUGH 30 NOVEMBER
(In Feet NGVD)

Management		W/O Management Units			With MU	
Unit	Present	FWO	NED	RCMD	EQ	RCMD
Henderson	15.9	14.3	13.2	13.4	15.4	15.4
Lost Lake	16.9	15.6	14.3	14.5	16.9	-
Cow Island Lake	16.7	15.4	14.1	14.3	16.7	-
Warner Lake	16.7	15.4	14.1	14.3	16.7	-
Cocodrie Swamp	13.6	12.3	11.0	11.2	13.6	13.6
Beau Bayou	11.5	10.0	8.5	8.9	12.9	12.9
Buffalo Cove	9.9	8.8	7.5	7.8	10.1	10.1
Alabama Bayou	12.3	10.8	9.7	10.0	18.3	-
Bayou Des Glaises	12.3	10.8	9.7	10.0	12.7	-
Pigeon Bay	10.2	8.7	7.5	7.7	10.8	-
Flat Lake	6.8	5.5	4.4	4.6	6.8	6.8
Upper Belle River	5.5	5.0	3.4	4.2	6.3	-

FREQUENCY CURVES - BACKWATER AREA

C.1.48. The backwater area east of Morgan City is bounded on the west by the East Atchafalaya Basin Protection Levee (EABPL), on the east by the Mississippi River levee and Bayou Lafourche Ridge, and on the north by Lower Grand River and Bayou Plaquemine (Plate C-48). This area was cut off from direct flooding of the Atchafalaya River and Mississippi River by construction of the EABPL and the Mississippi River levees. However, backwater from the Lower Atchafalaya River can cause considerable increases in the water level in the vicinity of Bayou Boeuf which, in turn, increases flooding in the Lake Verret watershed by hindering the runoff from the area.

C.1.49. This area is not only subject to backwater flooding but is also subject to tidal flooding and headwater flooding. Tidal flooding is caused by wind-generated tides in the marshes and bays that act as a buffer in the Gulf of Mexico. The most severe tides occur during a hurricane. During Hurricane Audrey in June 1957, the combination of wind, significant river discharge, and simultaneous rainfall over the areas produced stages at Morgan City as high as 8.5 feet and 3.3 feet at Pierre Pass. Singularly, tidal flooding has been the predominant influence less than 1 percent of the time. The tides may be only 2 feet in height and of little significance when they occur singularly.

C.1.50. Headwater flooding has been the predominant influence slightly less than one-half of the time. This type of flooding which occurs because rainfall in the watershed is greater than the drainage system and natural storage system can accommodate, is usually of relatively short duration.

C.1.51. Backwater flooding has been predominant slightly more than one-half of the time and is by its nature almost invariably an inseparable combination of wind tides, rainfall runoff, and river-induced backwater. Flooding caused by backwater from the Atchafalaya River is usually of extended duration.

C.1.52. The Avoca Island levee was constructed to limit the project design flood stages in the backwater area to generally the same areas as those inundated in the 1945 flood. However, as development of the Atchafalaya River delta has taken place, the stage at the end of the levee for the project flood has escalated and the degree of backwater flooding has increased. As deltaic development continues, the mouth of the Atchafalaya River will continue to move gulfward, and stages at the end of the levee, and therefore stages in the backwater area due to backwater flooding, will continue to increase.

C.1.53. In contrast to the backwater flooding, the degree of flooding in the backwater area caused by tide or headwater runoff will remain constant, since these are caused by hydrologic conditions and are not affected by deltaic activity. For this reason, the percentage of time that backwater is the predominant influence of flooding is expected to increase from slightly more than one-half of the time, as it is now, to somewhat more than two-thirds of the time.

C.1.54. Stage-frequency curves were developed from historical data gaging stations in the backwater area (Plate C-48). Peak stages were used for the period of record (1957-1975). The stages were individually adjusted to represent peak stages with a mean tide in the Gulf of Mexico. The Plotting Position Method, as described in "Statistical Methods in Hydrology" by Leo R. Beard, was applied to the adjusted data to develop a stage-frequency curve at each location for present conditions.

C.1.55. Computations using HEC-2 were performed to quantify the effects delta development will have on stages at the end of the Avoca Island levee. This increase in stages was extrapolated to the gaging stations in the backwater area to obtain stage-frequency curves for future conditions. A similar computation was performed to develop stage-frequency curves for future conditions with the extension of the Avoca Island levee.

C.1.56. The curves described previously include the effects of backwater flooding, headwater flooding, and mean tide conditions. Additional stage-frequency curves were developed at selected stations to represent rainfall only with a mean tide. Stage-frequency curves for all the conditions discussed above are shown in Plates C-49 through C-54.

DURATION CURVES

C.1.57. Stage-duration curves were developed for the gaging stations in the backwater area described previously. These curves were developed from historical data, modified in the same manner as the stage-frequency curves. These curves are shown on Plates C-55 through C-60.

DELTA DEVELOPMENT

C.1.58. The Atchafalaya Bay is an actively building delta of the Atchafalaya River and is an ongoing subject of extensive study by aerial and land reconnaissance. Through these studies, past development has been cataloged, and projections of the amount of land expected to form in the next 50 years have been made (Plate C-61). Since the formation of the delta is not only caused by the sediment load of the Atchafalaya River but by wind and wave action of the bay, locations of the projected land development have not been specifically identified; only a gross area of development is shown (Plate C-62).

C.1.59. A hybrid modeling effort utilizing 12 mathematical and physical models is currently being undertaken by WES to develop a set of tools to predict evolution of the Atchafalaya River delta and effects of that evolution. Once complete, the model will provide a measure of refining predictions of develoment of the bay.

ISOHALINES

C.1.60. The salt-freshwater interface of the Atchafalaya Bay and vicinity is of vital importance to environmental concerns. The

marshes in this area contribute considerably to the fish and wildlife production of the Atchafalaya. To identify the effect alternatives would have on this salt-freshwater interface, salinity isohalines were drawn for the area from the Terrebonne marsh to Vermilion Bay. The maps shown on Plates C-63 to C-80 contain salinity isohalines for 0.5, 5.0, 10.0, 15.0, and 20.0 parts per thousand (ppt).

C.1.61. The existing conditions isohalines were developed from salinity data taken from 1974-1978 from 28 stations. Additional data obtained by the State of Louisiana were also used. Salinity data for each station were plotted versus Atchafalaya River discharges for corresponding dates. The data resulted in a plot with considerable scatter. A curve was drawn through the data to represent average conditions. To assist in locating this curve, ground truth information was used. This information consisted of locations of specific marsh types, location of oyster beds, and the salinity required to produce these habitats. After drawing a curve through the scatter of data, salinities were read from the curve for discharges of 320,000 cfs and 90,000 cfs. These values were located on the map and isohalines were then drawn through the data to represent present conditions. The same curves were used to estimate salinities for various distribution of flow between Wax Lake Outlet and the Lower Atchafalaya River for present conditions.

C.1.62. The future conditions isohalines were superimposed on the shoreline geography projected for the year 2030. Since the mouths of the two outlets will be located on the open gulf rather than the present bay-marsh system, allowances had to be made for the introduction of freshwater directly into open gulf waters. In addition, allowances were made for the reduction in future freshwater flows into surrounding marsh areas, a condition which will also result from the more direct outflow of freshwater into the gulf. With these concepts in mind, the future isohalines were shaped in a manner similar to those described for present conditions. Salinity gradients were found to be more severe near the mouths of the outlets because of the abrupt contact with open gulf waters. Salinity intrusion into the eastern marshes was hypothesized due to the reduction in freshwater flows into these areas. Salinity levels in East Cote Blanche Bay will be noticeably reduced by future flows. West Cote Blanche Bay and Vermilion Bay were not as affected by these future conditions.

PROJECT FLOOD FLOWLINES

C.1.63. General. The Atchafalaya Basin Floodway is being constructed to convey 1,500,000 cfs to the Gulf of Mexico during a project flood. Use of the area as a floodway is the primary use. The effect each alternative plan will have on the project flood was evaluated and demonstrated by the project flood flowlines.

C.1.64. The interrelation between various alternatives makes it nearly impossible to define the effect of any single alternative. It is a combination of alternatives that influences the flowline. For example, channel training in the Lower Atchafalaya Floodway would have a certain effect on the flowline when combined with a 70/30 distribution control of the outlets, but would have considerably less effect if the distribution of flow in the outlets is not controlled.

C.1.65. In the earlier investigations, about 45 flowline computations were made for various combinations of alternatives in an attempt to identify the effects of each alternative on the flowline. These flowlines were used in the early plan formulation as described in Appendix B and are not presented here. The flowlines shown in Tables C-1-2 through C-1-11, calculated for the plans or combination of alternatives, were selected for presentation in this report. Levee stations are shown on Plate C-24.

C.1.66. Design Reaches. The Atchafalaya Basin was divided into six reaches (or runs), each representing one totally defined element of the basin. This includes function, geographical location, and discharge. The six reaches are shown on Plate C-81 and are described as follows.

- Lower Atchafalaya River. The existing mouth of the Lower Atchafalaya River is at mile 135.8; for 2030 conditions; this has been extended to mile 152.0. This reach covers the area from mile 103.0 to the mouth of the river. Overbank areas have been extended to represent future conditions.

C.1.67. The project design discharge for the latitude of the outlets is 1,500,000 cfs. The distribution of flow through the outlets was determined by balancing the water surface elevation for Wax Lake Outlet and the Lower Atchafalaya River at their junction. This was done by developing a rating curve for each outlet. The rating curves were drawn by running discharges in increments of 100,000 cfs down each outlet. Each run used a starting water surface elevation of 5 feet to simulate extreme high tide in the bay.

C.1.68. The rating curves were plotted on a single graph (Plate C-82). Knowing the total latitude flow at the outlets, the combined rating curve will give the discharge in each outlet and the starting water surface elevation for the Middle Basin run. A similar combined rating curve was prepared for each alternative plan in this manner.

TABLE C-1-2

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - EAST BANK LEVEE
SIMMESPORT TO MORGANZA UPPER GUIDE LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
250+00	59.2	59.4	58.4	58.4	58.4	58.4
883+00	54.5	54.5	53.6	53.6	53.6	53.6
1305+93	50.3	50.5	49.6	49.3	49.3	49.3

TABLE C-1-3

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - EAST BANK LEVEE
MORGANZA UPPER GUIDE LEVEE TO END

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
1305+93	45.7	46.6	46.0	46.1	46.1	46.1
1360+00	45.4	46.2	45.6	45.6	45.6	45.6
1851+00	42.0	43.0	41.6	41.6	41.6	41.6
2110+00	38.5	39.6	38.7	38.7	38.7	38.7
2404+00	35.6	36.9	35.9	35.9	35.9	35.9
2769+25	30.3	31.9	30.7	30.7	30.7	30.7

TABLE C-1-4

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - WEST BANK LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
429+00	59.2	59.2	58.2	58.1	58.1	58.1
1010+00	54.8	55.3	54.2	54.2	54.2	54.2
1213+00	53.3	53.8	52.9	52.9	52.9	52.9
1445+00	51.1	51.7	50.6	50.5	50.5	50.5
2081+00	45.7	46.7	45.5	45.5	45.5	45.5
2380+00	42.7	43.7	42.6	42.4	42.4	42.4
2774+00	38.9	40.3	39.3	39.0	39.0	39.0
2996+00	36.3	37.9	35.8	35.6	35.6	35.6

TABLE C-1-5

PROJECT FLOOD FLOWLINES
ATCHAFALAYA RIVER - BUTTE LAROSE LEVEE

Design Flowline Elevations, Feet NGVD

Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
3005+00	33.0	34.3	33.2	33.0	33.1	33.0
3600+00	26.5	28.2	27.7	27.4	27.5	27.4

TABLE C-1-6

PROJECT FLOOD FLOWLINES
MORGANZA FLOODWAY - UPPER GUIDE LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
0+00	58.7	58.7	58.7	58.7	58.7	58.7
159+40	58.7	58.7	58.7	58.7	58.7	58.7
161+00	54.8	55.0	54.9	54.9	54.9	54.9
359+50	52.9	53.2	52.9	52.9	52.9	52.9
630+03.9	49.0	50.4	50.0	50.0	50.0	50.0

TABLE C-1-7

PROJECT FLOOD FLOWLINES
MORGANZA FLOODWAY - LOWER GUIDE LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
5+75	57.6	57.6	57.6	57.6	57.6	57.6
380+00	48.3	49.5	49.4	48.7	48.8	48.7
587+00	45.7	47.4	47.2	46.1	46.2	46.1
858+00	41.8	42.9	42.2	42.2	42.3	42.2
1033+43	38.8	40.3	39.3	39.2	39.3	39.2

TABLE C-1-8

PROJECT FLOOD FLOWLINES
EAST ATCHAFALAYA BASIN PROTECTION LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
1033+43	38.8	40.3	39.2	39.2	39.3	39.2
1316+00	37.1	38.4	37.5	37.4	37.5	37.4
1629+00	35.5	37.1	36.2	36.0	36.2	36.0
1858+00	34.4	36.0	35.0	34.7	34.9	34.6
1915+00	33.7	35.1	34.3	34.2	34.2	34.0
2188+00	32.2	33.6	32.6	32.4	32.7	32.4
2580+00	30.5	31.9	30.8	30.5	30.7	30.4
2773+00	30.1	31.4	30.4	30.1	30.2	29.9
2950+60.5	29.7	31.1	30.0	29.7	29.7	29.4
770+00	29.3	30.5	29.4	29.0	29.4	28.9
899+00	28.8	30.2	29.1	28.7	28.9	28.5
1100+00	28.4	29.7	28.5	28.2	28.4	28.0
1361+00	27.5	28.7	27.4	27.0	27.2	27.0
1554+00	26.8	28.0	26.4	26.0	26.2	25.7
1620+00	26.3	27.5	26.0	25.6	25.8	25.3
1700+00	25.8	26.9	25.4	25.0	25.2	24.6
1780+00	25.4	26.2	24.8	24.3	24.6	23.9
1960+00	24.2	24.4	23.3	22.8	23.1	22.3
2040+00	23.7	23.7	22.8	22.3	22.7	21.6
2090+00	23.3	23.3	22.7	22.1	22.6	21.5
2210+00	22.8	22.8	22.1	21.8	22.1	21.0
2400+46= 66+74	21.2	21.2	20.1	20.2	20.2	18.9
0+00	19.3	19.3	18.1	18.2	18.5	16.5

TABLE C-1-9

PROJECT FLOOD FLOWLINES
LEVEE SOUTH OF MORGAN CITY (AVOCA ISLAND)

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
0+00	18.0	18.0	17.3	17.2	17.4	15.4
128+33[1/]	18.0	18.0	17.3	17.2	17.4	15.4
1+13.8[2/]	18.0	18.0	17.3	17.2	17.4	15.4
200+00	16.3	16.3	15.4	16.8	17.1	14.8
349+00	15.1	15.1	14.1	16.1	16.3	13.6
457+00	14.3	14.3	13.6	15.8	16.1	13.0
680+00	13.2	13.2	12.4	14.4	14.8	11.9

[1/] N Edge Bayou Boeuf Lock

[2/] S Edge Bayou Boeuf Lock

TABLE C-1-10

PROJECT FLOOD FLOWLINES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
0+00	57.1	57.1	57.0	57.0	57.0	57.0
511+00	49.0	49.0	49.0	49.0	49.0	49.0
990+00	46.4	46.4	46.4	46.4	46.4	46.4
1395+00	43.7	44.3	44.3	44.2	44.2	44.2
1788+00	41.0	41.9	41.9	41.4	41.4	41.4
2182+00	38.9	39.9	39.9	39.6	39.6	39.6
2510+00	37.4	38.8	38.8	38.7	38.7	38.6
2902+00	35.6	37.2	36.1	36.0	36.0	35.9
3310+00	32.2	33.7	32.6	32.3	32.6	32.4
3560+00	31.2	32.6	31.6	31.4	31.4	31.1
3698+00	30.9	32.2	31.1	31.0	31.0	30.7
3957+00	30.1	31.5	30.4	30.0	30.3	29.9
4269+00	29.2	30.6	29.4	29.0	29.3	28.9
4547+00	28.7	30.0	28.8	28.4	28.6	28.2
4717+00	28.5	29.8	28.5	28.1	28.3	28.0
4947+00	27.8	29.1	27.6	27.3	27.6	27.1
5100+00	27.2	28.5	27.1	26.2	27.0	26.5
5493+00	25.2	25.2	24.5	24.0	24.3	23.5
5644+00	23.5	23.5	21.8	21.1	21.3	20.1

TABLE C-1-10 (Continued)

PROJECT FLOOD FLOWLINES
WEST ATCHAFALAYA BASIN PROTECTION LEVEE

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
West Calumet Floodgate						
5730+09	20.6	20.6	19.0	18.1	18.3	17.6
5817+00	23.2	23.2	21.6	21.0	21.2	20.4
5914+00	24.3	24.3	23.0	22.3	22.7	21.9
6030+00	24.1	24.1	23.1	22.7	23.0	22.0
6336+00	23.2	23.2	22.5	22.1	22.5	21.4
6433+00	22.5	22.5	22.0	21.9	21.5	20.2
6551+28= 625+07	20.9	20.9	19.2	19.7	19.8	18.4
703+50	17.9	17.9	16.9	18.0	18.5	16.7
838+87= 0+00	17.0	17.0	15.9	17.2	17.5	15.3
60+00	15.7	15.7	14.7	16.4	16.7	14.2

TABLE C-1-11

PROJECT FLOOD FLOWLINES
LEVEES WEST OF BERWICK

	Design Flowline Elevations, Feet NGVD					
Station	Refined 1973 MR&T	FWOC	EQ	NED	TS	RCMD
Wax Lake East						
60+00	15.7	15.7	14.7	16.4	16.7	14.2
356+00	13.6	13.6	14.9	15.4	15.6	15.0
508+85= 268+84	14.0	14.0	15.8	15.9	16.1	15.6
Wax Lake Outlet East						
268+84	14.0	14.0	15.8	15.9	16.1	15.6
179+50	16.8	16.8	17.3	17.2	17.4	16.7
160+82	20.6	20.6	18.1	18.1	18.4	17.6
Wax Lake Outlet West						
143+04	20.6	20.6	18.1	18.1	18.4	17.6
320+04	13.6	13.6	15.0	15.5	15.6	15.1
0+00	13.6	13.6	15.0	15.6	15.7	15.3
269+00	10.4	10.4	13.4	14.1	14.2	13.9
East Bayou Sale						
273+75	10.0	10.0	13.1	13.9	13.9	13.6
190+00	9.8	9.8	12.9	13.8	13.8	13.5
0+00	9.4	9.4	12.5	13.6	13.6	13.3

C.1.69. The project flood flowline was computed for the Lower Atchafalaya River and Wax Lake Outlet using the discharges obtained from the combined rating curve and a starting water surface elevation of 5 feet.

• Wax Lake Outlet. The existing mouth of Wax Lake Outlet is at mile 122.0. For 2030 conditions this has been extended to mile 136.0. This reach covers the area from mile 104.7 to the mouth of the outlet. Overbank areas have been extended to represent future conditions. Design flow for Wax Lake Outlet is determined along with the flow for the Lower Atchafalaya River as described previously.

• Middle Basin. This reach extends from mile 107.0 to mile 53.49. The overbank areas extend eastward to the EABPL and westward to the WABPL. The project flood discharge for the middle basin is 1,500,000 cfs. The middle basin reach is also used to define the project flood flowline for the Butte LaRose levee. This levee is authorized to have a grade to confine a flow of 1,000,000 cfs supplied by the river and Morganza Floodway; therefore, the flowlines for this levee reflect this lower than project floodflow condition.

• Atchafalaya River from Whiskey Bay Pilot Channel to Old River. This reach extends from mile 53.5 to Old River and computes the flowline for both river levees. Because of the varying functions of the river levees the flowlines for this reach were divided into three segments, each with a different design discharge. The Atchafalaya River east bank levee from Simmesport to junction with Morganza upper guide levee (Reach 1 of Plate C-81), uses a design discharge of 832,000 cfs in the Atchafalaya River and 1,500,000 cfs in the Middle Basin. The Atchafalaya River east bank levee, Morganza upper guide levee to Alabama Bayou (Reach 2, Plate C-81), uses 800,000 cfs in the Atchafalaya River and 800,000 cfs in the Middle Basin. The Atchafalaya River west bank levee, Simmesport to junction with the Butte LaRose levee (Reach 3 of Plate C-81), uses 832,000 cfs in the Atchafalaya River and 1,432,000 cfs in the Middle Basin. Derivation of these design discharges is explained in "MR&T Project Flood Flowline Review Report," December 1976, revised September 1977.

• West Atchafalaya Floodway. This reach extends from mile 53.5 northward to the fuseplug levee west of Simmesport. The design discharge is 250,000 cfs above Bayou Current and 400,000 cfs below Bayou Current. Since the West Atchafalaya Floodway is operated after operation of the Atchafalaya River and Morganza Floodway, the starting elevation for these computations is based on a discharge of 1,500,000 cfs in the Middle Basin.

• Morganza Floodway. This reach extends from mile 53.5 up to the Morganza control structure and provides design flowlines for the Morganza upper and lower guide levees. The design discharge is 600,000 cfs with 1,500,000 cfs in the Middle Basin.

C.1.70. <u>Computational Procedure</u>. The project flood flowlines were computed by use of the HEC-2 computer program described previously. Details of the model calibration can be found in the "MR&T Project Flood Flowline Review Report," December 1976, revised September 1977.

C.1.71. For each alternative plan, channel cross sections were coded, based on the following:

- Channel areas based on projections shown on the channel development curves.

- Projection of the amount of sediment deposition on overbanks and delta development.

- Alternative features of the plan such as channel training, widening Wax Lake Outlet, and the Avoca Island levee extension.

C.1.72. Computations began by construction of the combined rating curve for the Lower Atchafalaya River and Wax Lake Outlet. From this curve the design discharges for each outlet and the starting water surface elevation for the Middle Basin run were obtained. The Lower Atchafalaya River run with this discharge provides design grades for the Avoca Island levee, Morgan City, Tiger Island and Berwick floodwalls, and the lower end of the EABPL.

C.1.73. Results from the Wax Lake Outlet run were used for design grades for the Wax Lake Outlet levees the lower end of the WABPL, and the levees west of Wax Lake Outlet.

C.1.74. Computations from the Middle Basin run were performed next to establish design grades on the EABPL and WABPL. This reach also had to be run for the appropriate discharges to establish starting water surface elevations for the Atchafalaya River levees.

C.1.75. Computation of the design grades for the Atchafalaya River levees, Morganza levees, and WABPL adjacent to the West Atchafalaya Floodway completed the flowline calculations.

Section 2 - EVALUATION OF ALTERNATIVES

GENERAL

C.2.1. Detailed descriptions of alternative features considered by this study are contained in the main report. The following paragraphs present a summary of the hydraulic evaluation of the alternatives. Those alternatives eliminated from further investigation, during the plan formulation of the study, are not covered here, except for those, such as Old River control diversion for which flood control considerations were the major factor in the elimination of the alternative.

OLD RIVER CONTROL

C.2.2 Old River control was constructed and put into operation in 1963 to restrict the quantity of flow diverted to the Atchafalaya River in order to combat the capture of the Mississippi River. The distribution of total latitude flow between the Mississippi and Atchafalaya Rivers below Old River is regulated to 70/30 (70 percent to the Mississippi River and 30 percent to the Atchafalaya River) on an annual basis in accordance with the authorizing law (Flood Control Act of 1954). Investigations were made to change this distribution to divert either more or less water to the Atchafalaya River.

C.2.3. As described in Appendix B, several distributions of flow at Old River were considered. These included 70/30, 60/40, 65/35, and 80/20 distributions. It also included operating the complex to maintain a 35-, 40-, or 45-foot water surface elevation at Acme, Louisiana, when the differential head on the structure would allow. An additional alternative attempted to maintain 35 feet at Acme without a differential head restriction. For each of these alternatives, the discharge hydrographs for both the Mississippi and Atchafalaya Rivers were computed, using as a base the observed hydrographs of 1949-1974. The effects of each distribution in the floodway, saltwater intrusion, and land use were determined.

C.2.4. The alternatives that diverted a smaller percent of the flow to the Atchafalaya River (80/20, and 35, 40, and 45 feet at Acme) tended to cause less development in the Atchafalaya Basin outlets and thereby a higher flowline in this critical area. Other reasons for eliminating these alternatives from further consideration during the plan formulation stage are addressed in Appendix B. Reasons for eliminating the 60/40 and 65/35 distributions from further consideration are largely hydraulic in nature and are addressed in the following paragraphs.

C.2.5. The definitive study of the relationship between the Mississippi and Atchafalaya Rivers, performed in 1952, is entitled

"Geologic Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion." That study predicted that a critical stage in the relationship would occur when diversions from the Mississippi River at the natural Old River connection reached about 40 percent of the Mississippi River flow. Had natural conditions been allowed to continue until the present time, it is estimated that the distribution of flow would now be 55/45, and the behavior of the Mississippi River would, no doubt, be marked by great instability. Events have provided data that demonstrate that the critical stage was actually closely approached in the 1973-1975 time period at a distribution of only 65/35.

C.2.6. In 1976, operation of Old River proceeded with the goal of maintaining a 70/30 distribution on a daily basis. Prior to that time, distribution of flows was not controlled daily and in 1974, the Mississippi River carried as little as 56 percent of the daily latitude flow. Under the influence of daily control, steady increases in channel capacity at Tarbert Landing were reflected by the rating curves in 1977, 1978, and the early part of 1979. Events during the 1979 flood showed the Mississippi River to be subject to rapid change. Large amounts of deposition in May 1979 caused a significant rise in the rating curve at Tarbert Landing. It is likely that if the 1979 flood had occurred with the 1975 channel conditions, peak stages at Old River control would have been substantially higher than those actually encountered.

C.2.7. While the events of the 1979 flood do not, in themselves, comprise an unassailable case for maintaining a 70/30 distribution of latitude flow, combined with the behavior of the Tarbert Landing rating curves in 1976, 1977, and 1978, they do indicate very clearly that any change in that distribution toward placing a greater share of total latitude flow into the Atchafalaya River would be risky, if not irresponsible. This conclusion is supported by the results of movable bed model studies and numerical model studies.

C.2.8. A plan to maintain less than a 70 percent distribution to the Mississippi River would cause rapid deterioration in the flow capacity of the Mississippi River over substantial lengths of the channel. This instability would mandate a change in the distribution of project floodflow, and the Atchafalaya Basin would have to accept a greater share of that flow, but could, in all probability, not accommodate such flow within the basin's levee system.

C.2.9. Based on studies to date, including those that support the authorization of Old River control, and in particular the analysis of the behavior of the Atchafalaya and Mississippi Rivers over the period of 1973 to date, it has been concluded that, to maintain a stable relationship between the two streams, not less than 70 percent of the total annual volume of latitude flow should be passed through the Morganza-Old River reach of the Mississippi River. Day-to-day

departures from this general operating rule are permissible, but the margin for such departures is quite narrow. Two factors, primarily, contribute to this. First, it is impossible to predict the subsequent hydrograph of latitude flow; and second, the ability to redress volumetric imbalances, created by departures from the general operating rule which favors flow in the Atchafalaya River, is constrained by the allowable differential heads that may be safely imposed on the low sill structure. Combined, these two factors would preclude assurance that, having diverted additional flow to the Atchafalaya River, the imbalance created could, in fact, be subsequently corrected. The greater the total flow at which the departure occurs, the greater the likelihood that it will be impossible to meet the requirements of the general rule.

CHANNEL DEVELOPMENT

C.2.10. The Atchafalaya River main channel consists of: a leveed reach from the junction of Red River and Old River to mile 55; the main channel of the floodway to about mile 100; a channel through former lakes; and the outlets to the gulf. Hydrographic surveys of the channels have been made periodically since the late 1800's. The channel area calculations represent the area below the 1963 flowline, which is a fixed datum. The areas for several cross sections spread over a few miles are averaged for each survey to give the average area for a reach. The areas for several reaches were averaged to get average channel areas for mile 0-54.8 (leveed reach), mile 54.8-65.4 (Whiskey Bay Pilot Channel), mile 65.4-100.8 (distributary reach), mile 100.8-113.7 (lake area), mile 105.5-124.0 (Wax Lake Outlet), and mile 113.7-136.8 (Lower Atchafalaya River).

C.2.11. Since removal of the rafts in the Atchafalaya River in 1855, the cross-sectional area has continued to increase; the lakes in the lower part of the basin have filled with sediments; and the development of a main channel through the lakes has taken place. The objective of dredging the main channel from 1955 to 1968 was to accelerate development of this channel. Concurrent with the dredging program, closure of 22 distributaries was accomplished to confine a larger percent of the flow to the main channel which, in turn, accelerates the natural erosive action of the river to establish a larger main channel. Projections of future channel development were based upon projections of changes in flow distribution and to some extent model results of the computer model HEC-6. As shown on Plates C-1 through C-8 the area of the river has progressed to approximately 118,000 sf from mile 0 to mile 54.8; to 92,000 sf from mile 54.8 to 65.4; to 80,000 sf from mile 65.4 to 100.8, and to 38,000 sf from mile 100.8 to 113.7. The area of the Lower Atchafalaya River (mile 113.7-136.8) has decreased to about 69,000 sf. This is primarily due to the loss of flow to the Wax Lake Outlet, which has increased its area to 38,000 sf.

C.2.12. No Action. If no further action is taken in the basin, the area of the main channel would continue to increase as shown on the channel development curves (Plates C-1 through C-8). The continued channel enlargement of the leveed reach of the river will result in a 121,000-sf channel by the year 2030. As the natural levees of the main channel in the Lower Atchafalaya Basin Floodway are formed, a larger percentage of the flow will be confined to the channel and will result in its continued natural enlargement. The channel cross-sectional area between mile 54.8 and 65.4 is projected to increase to 110,000 sf. Between mile 65.4 and mile 100.8, the channel cross section will increase to 98,000 sf.

C.2.13. Wax Lake Outlet, with its gradient advantage for flow to the gulf over the Lower Atchafalaya River, will continue to convey an increasing percent of the latitude flow. It is estimated that by 2030, approximately 50 percent of the latitude flow will be conveyed through Wax Lake Outlet. Concurrent with this increasing flow, the cross-sectional area of Wax Lake Outlet will increase to about 51,000 sf. Because of the concurrent decreases in flow, the main channel's cross section below river mile 100 will decrease in area. From mile 100.8 to mile 113.7 the area is projected to decrease in size to about 17,000 sf by 2030. The area of the Lower Atchafalaya River (mile 113.7 to 136.0) will decrease to about 47,000 sf.

C.2.14. This evident shift in the distribution of flow through the outlets, toward a larger part of the total flow being conveyed by Wax Lake Outlet, will have the effect of a loss in total conveyance capacity of the outlets. This, along with the projected overbank sediment deposition, will cause the project flood flowline to become higher than if some alternate action were taken. The no-action flowline is projected to be higher than the 1973 refined flowline by up to 1.5 feet. This higher flowline effect extends along the EABPL, WABPL, Morganza Floodway levees, and the Atchafalaya River levees.

C.2.15. The no-action alternative or without-project condition affects the average stage hydrographs in the same manner as the project flood flowline. The peak stages expected for the average hydrograph will be higher for no-action than they will be if preventive alternative actions were taken. The differences in magnitude are generally between 1 and 2 feet higher for all areas of the basin and are shown in the average stage hydrographs for each management unit area (Plates C-28 through C-36).

C.2.16. Dredge 100,000-sf Channel. The dredged 100,000-sf channel plan, as presented in 1963, calls for dredging from mile 54.5 to mile 111.9 in steps of 60,000 sf, 80,000 sf, and 100,000 sf. The plan included continuous monitoring to determine if the next step of dredging would be required.

C.2.17. Of the 443,000,000 cubic yards (cy) of dredging expected in 1963, 158,000,000 cy were completed through 1968. Due to the natural

erosive action of the river, enlargement has continued since 1968 so that it is now estimated that 240,000,000 cy would need to be dredged to complete the project. The plan also included closure of the Atchafalaya River just below the Whiskey Bay Pilot Channel.

C.2.18. Development of the main channel is an important factor in flood control, since the main channel is expected to carry one-third of the basin flow during a project flood. Development of the main channel through dredging is the most expeditious manner of obtaining a floodway capable of conveying the project flood.

C.2.19. Channel Training. Channel training is a process consisting of dredging material from the channel and placing it on the bank, to simulate the development of natural ridges. Once in place the training works would confine more flow to the channel, which not only tends to accelerate its development, but reduces the overbank deposition occurring during the project life.

C.2.20. The channel training plan would authorize training works on both sides of the main channel, extending from the end of the river levees to the bay, and including both the Lower Atchafalaya River and Wax Lake Outlet. The training works above the outlets would be completely confining works; that is, there would be no gaps in the works to allow water to flow over the banks during low flows. The training works on the Lower Atchafalaya River and Wax Lake Outlet would not be completely confining works. Gaps would be left between disposal areas to allow for continued development of the overbank marshes. All the training works would be constructed to a height equal to that of the average annual high water of the area. This would allow, on the average, bi-annual overflow of the river.

C.2.21. Actual construction of channel training works would not be required over all the area described above. The majority of the works would be below mile 100. Above mile 100, the work would consist of closing gaps between existing disposal areas, elevating depressions in the natural levee, and maintaining the channel training works.

C.2.22. An additional integral part of channel training below Morgan City is the closure of Bayou Shaffer. Currently, Bayou Shaffer conveys about 12 percent of the flow that passes Morgan City. The closure of Bayou Shaffer will require all of this flow to be conveyed by the Lower Atchafalaya River. Since this closure and the channel training works would confine a larger quantity of water to the channel, a larger cross-sectional area could be maintained, resulting in a lower flood flowline.

C.2.23. Calculations performed during the earlier plan formulation stage of this study indicated that channel training above Morgan City would provide a net dollar savings by reducing the height to which levees would have to be constructed. The channel training works

resulted in an average reduction in the project flood flowline for future conditions for the EABPL and WABPL of about 0.5 foot. This comparison was made between conditions with channel training and between conditions with only natural development of the main channel. Other features included in this comparison that were common to both computations were 70/30 control of the outlets and widening the Wax Lake Outlet overbank.

C.2.24. Plan formulation calculations also indicated that channel training of the outlets and closure of Bayou Shaffer would provide a net benefit. Flowline calculations comparing conditions with and without channel training indicated that the flowline at Morgan City and Wax Lake Outlet could be reduced by about 1.0 foot. This reduction in flowline averaged about 0.5 foot for the EABPL and WABPL. Common features to this comparison were channel training on the Lower Atchafalaya Floodway, 70/30 control of the outlets, and widening the Wax Lake Outlet overbank.

C.2.25. Additional benefits from channel training are received because it will accelerate the time period in which the floodway will become capable of conveying the project flood. This acceleration is achieved by dredging to build the training works, which in itself enlarges the channel, and by a reduction in overbank deposition in the early years of the project.

OVERBANK DEVELOPMENT

C.2.26. The overbank area studied includes Atchafalaya Bay and all the area between the east and west protection levees, exclusive of the main channel. Sediment deposition on the overbanks reduces flow capacity and, therefore, causes a rise in the flowline. The area-elevation curves described earlier were used to illustrate projected changes in overbank deposition. Channel development alternatives have a considerable effect on the amount of overbank deposition. These effects were included in the area-elevation curves. Additional alternatives to reduce overbank deposition were considered and are discussed subsequently.

C.2.27. No Action. The process of a river overflowing its banks and depositing sediments in the adjacent land areas is a natural developing process of a young (in geologic time) river, such as, the Atchafalaya. Each year as the river conveys spring floods to the gulf, it will overflow its banks and continue to deposit sediments in the flooded overbank areas.

C.2.28. Projections of river overflow sediment deposits in the overbank areas are shown by the area-elevation curves for each management unit area (Plates C-9 through C-19). As the natural levees

within the Atchafalaya Basin build up to higher elevations from yearly overflows, the quantities of water diverted to the overbank areas will gradually decrease; therefore, the quantities of sediment deposited or rate of sediment deposition on the overbank areas would be expected to decrease over time. While the most significant amounts of deposition have already taken place over most of the basin, additional sediment deposition of up to 9 feet could occur in some areas.

C.2.29. The most significant areas of sediment deposition above the Teche Ridge will be in the lower lake areas. These areas are in a region where the main channel has yet to completely form natural levees; therefore, the overbanks are subject to frequent overflows. In the area of Sixmile and Grand Lakes, up to 9 feet of deposition can be expected. This building of the river banks in the area will eventually result in the main channel having confining natural levees throughout the Lower Atchafalaya Basin Floodway. The filling of the open water areas will continue and ultimately result in a relatively narrow channel through Sixmile Lake to Wax Lake Outlet.

C.2.30. Sediment deposition to the east of the main channel will not be as great in the more distant backswamps. For most of the Upper Belle River area, deposition of less than 2 feet is expected. This large area receives only about 16 percent of the total basin discharge, and the waters reaching the area will have already lost their heavy sediment load during the long distance traveled from the main channel. Because of the small amount of deposition expected, this area should maintain its present water regime. Like the Sixmile Lake area, higher deposition rates are expected in the southern and western portions of Upper Belle River as the main channel builds its natural levees; but since the main channel in this region is losing flow to Wax Lake Outlet, the deposition is expected to be no more than 5 feet and be confined to those lands within a mile of the main channel.

C.2.31. The area of Crevasse will be subject to up to 7 feet of sediment. This high rate of deposition is expected because practically all of the unit is located within the actively building natural levee portion of the main channel, and because of the significantly large volume of water that flows through Lake Chicot, Grand Lake, and Willow Cove during floods.

C.2.32. The Buffalo Cove area is bordered on the east by the main channel and on the west by Lake Fausse Pointe Cut. Because of the large flow conveyed through the Lake Fausse Point Cut (15 percent of the basin flow), Buffalo Cove is subject to levee building on both sides. Through the natural levee-building process, which has already taken place and the dredge disposal that was placed near the main channel, the eastern side of Buffalo Cove is already becoming a confining levee of the main channel. Along its western edge, particularly in the southwestern portion, water and sediment overflow into Buffalo Cove on a regular basis. In addition, access channels,

such as, the Si Bon Canal, convey a significant amount of water and sediment into the center of the area. These conditions subject the entire area of Buffalo Cove to about 5 feet of additional sediment deposition.

C.2.33. The remaining hydrologic areas of the Lower Atchafalaya Basin Floodway receive smaller quantities of water than those described above; therefore, expected deposition of sediments will be generally limited to the bank areas and will be less than 5 feet. Exceptions to this general pattern are the Warner Lake and Alabama Bayou areas. Warner Lake is completely surrounded by high banks and only about 1 foot of additional deposition is anticipated. Alabama Bayou is already well protected from main channel overflow by the east river levee. Therefore, except when the Morganza Floodway is operated, it is subject only to overflow from backwater that has already passed through most of the Bayou des Glaises area. Thus, no additional sediment deposition is expected in Alabama Bayou.

C.2.34. Sediment that passes through the Lower Atchafalaya Basin Floodway to the Atchafalaya Bay will continue to build the delta. As shown on Plate C-61, it is expected that about 300 square miles of land will emerge from this active deltaic process by the year 2030. If no action is taken to control flows through the outlets, Wax Lake Outlet will capture a larger share of the flow to be conveyed to the gulf. For this reason, a westward shift in the delta-building process will take place, with more land emerging near the mouth of Wax Lake Outlet.

C.2.35. Distributary Realinement. The Atchafalaya Basin main channel has four major distributaries. The Atchafalaya River at the head of the Whiskey Bay Pilot Channel distributes about 30 percent of the main channel flow to the western overbank areas. Some of this flow reenters the main channel 17 miles downstream through the west freshwater diversion channel. The west access channel diverts about 2 percent of the basin flow from the main channel near mile 75. The east freshwater diversion channel diverts about 3 percent of the basin flow from the main channel at mile 71.5, while the east access channel diverts about 3 percent of the basin flow from the main channel at mile 79. Along with the basin flow diverted from the main channel, these four distributaries divert sediments to the overbank areas.

C.2.36. The sediment transported by a distributary can be divided into two components: bed load and suspended load. The bed load consists of the coarser particles, or sand, and the suspended load generally consists of fine particles, such as silt and clay. There is no effective means to reduce the suspended load short of flocculation, which is extremely expensive and thereby infeasible for use in the Atchafalaya Basin Floodway. Bed load, on the other hand, can be effectively reduced in the distributaries.

C.2.37. At the present time, flow and the corresponding sediment load in the major distributary channels are diverted from the main channel at an angle of diversion of approximately 120 degrees, as shown in Figure C-2-1. A literature search of theoretical relationships and past model studies has shown that the alinement of the distributaries is such that they draw water from heavily sediment-laden, bottom currents of the main channel, and as much as 50 percent of the main channel bed load can be conveyed into the distributary and subsequently into the overbank areas. Realinement of each distributary to between 30 and 45 degrees (Figure C-2-2), can greatly reduce the bed load diverted to the distributary.

C.2.38. Since the sediment control features, both channel realinement and sediment traps, as described below would primarily have an effect on the sand size sediments, the amount of reduction of overbank deposition over the no-action deposition quantities has been estimated to be in proportion to the percent of sands in the suspended load (25 percent). This asumption has been made pending the results of an ongoing model study at WES of the west access channel realinement.

C.2.39. Sediment Traps. At each of the distributaries described previously, the use of sediment traps to remove sand-size sediments from the water column was investigated. The sediment traps would be rectangular and would in effect be an artificial deepening and widening of a reach of the distributary. The sediment traps, along with channel realinement, would reduce overbank deposition in the quantities described above.

C.2.40. The sediment traps were designed in the same manner that a settling basin for a treatment plant is designed. Sediment loads and grain sizes were obtained from sediment observations made in the distributary in 1975. Design details and annual maintenance estimates are shown in Table C-2-1. The excavated material would be placed on disposal areas parallel to the main channel to an approximately 20-foot depth. The disposal areas would not affect the project flood flowline because of their location.

OUTLET DISTRIBUTION

C.2.41. Wax Lake Outlet was completed in 1941, at which time it conveyed about 20 percent of the flow of the basin to the bay, while the Lower Atchafalaya River conveyed the remaining 80 percent. Since Wax Lake Outlet offers a shorter course to the bay than does the Lower Atchafalaya River, its share of the average flow has steadily increased to about 30 percent today. If nothing is done to prevent it, this trend will continue. Investigations were made on methods (and impacts) of changing the distribution to several alternatives, ranging from 100 percent through the Lower Atchafalaya River to 100

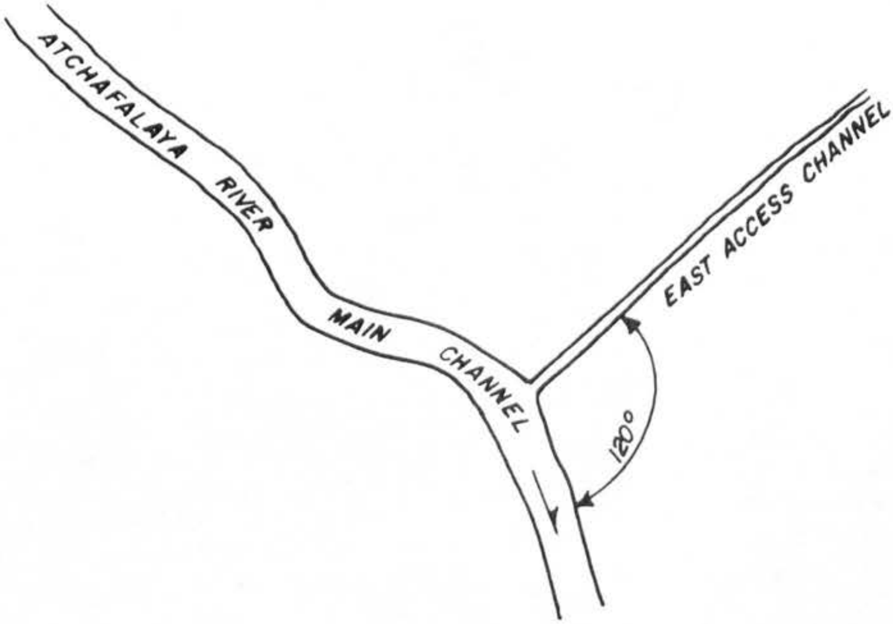


FIGURE C-2-1 TYPICAL EXISTING DISTRIBUTARY ALINEMENT

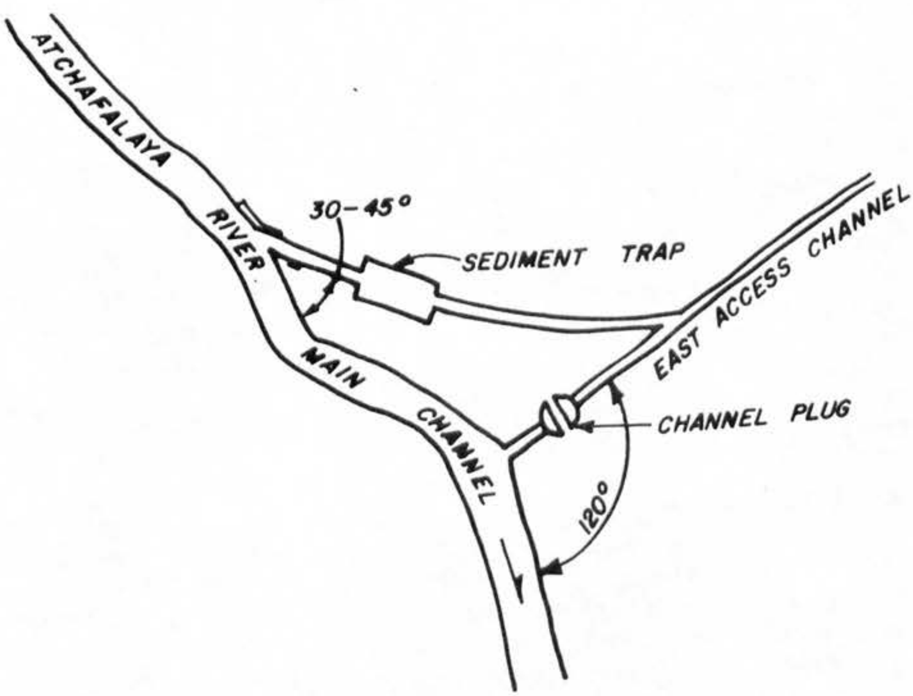


FIGURE C-2-2 TYPICAL DISTRIBUTARY REALINEMENT

TABLE C-2-1

SEDIMENT TRAP

Location	Width (feet)	Length (feet)	Bottom Elevation (ft NGVD)	Initial Excavation (cy)	Annual Maintenance (cy/yr)
No. 1 Atch. River at WBPC	1,400	2,500	-40.0	4,000,000	1,900,000
No. 2 West Access	300	1,000	-2.0	75,000	57,000
No. 3 East Freshwater	400	1,000	-10.0	215,000	90,000
No. 4 East Access	400	1,250	-10.0	275,000	80,000

percent through Wax Lake Outlet. Effects of each distribution are reflected in the channel development curves, the project flood flowlines, average hydrographs, and the isohalines.

C.2.42. No Action. The cross-sectional area of Wax Lake Outlet is currently about 38,000 sf. With the gradient advantage Wax Lake Outlet offers, this area would be expected to increase to 51,000 sf by the year 2030 (Plate C-2). Because of the loss of flow to Wax Lake Outlet, the area of the Lower Atchafalaya River would be expected to decrease from 69,000 to 47,000 sf. This shift in channel area is accompanied by a shift in the distribution of flow at the outlets. By the year 2030, the distribution of flow could be expected to be about 50/50. The shift in distribution results in a net loss in conveyance capacity of the outlets, thereby causing a rise in the project flood flowline. The shift in the distribution toward 50 percent through Wax Lake outlet will also increase maintenance dredging in the Lower Atchafalaya River. The shift would not affect the total quantity of delta emerging in the bay but would cause the location of the emerging delta to shift westward.

C.2.43. Control Outlet Distribution. The distribution of flow in the outlets is presently 70/30 (Lower Atchafalaya River/Wax Lake Outlet). An alternative to maintain this distribution consists of constructing a rock weir at the head of Grand Lake with connecting levees to the WABPL as shown on Plate 8 of the main report. The weir is designed to provide the 70/30 flow distribution for low and normal flows. For flood flows exceeding a 10-year frequency, the low connecting levees would be overtopped so that the flow could be safely conveyed to the outlet. The flow distribution for a project flood would be about 80/20.

C.2.44. Two alternatives to reduce the flow conveyed to Wax Lake Outlet were considered. One alternative required a gated control structure at the head of Grand Lake to maintain an 80/20 distribution, since velocities occurring at the diversion point exceeded the safe capacity for a rock weir. The second alternative consisted of a low-level closure at the head of Grand Lake to maintain a 100/0 distribution. Both alternatives include the same low-level levee as described for the 70/30 split so that flood flows could be safely conveyed to the gulf.

C.2.45. An alternative to restrict flows out of the Lower Atchafalaya River was also considered. A 0/100 distribution would be maintained by construction of a closure dam, flood control structure, and a lock at mile 115 on the Lower Atchafalaya River. Low and normal flows through the Lower Atchafalaya River would be stopped or curtailed sharply. The distribution of flood flow would also be changed, with the majority of flood flows being conveyed by Wax Lake Outlet. The control structure would be gated to regulate flows. The navigation lock would be similar in size to the one existing at Bayou Sorrel.

Enlargement of both the normal conveyance channel and the overbank channel at Wax Lake Outlet would be required.

C.2.46. Restricting the flow through the Lower Atchafalaya River was eliminated from further consideration during the plan formulation stages of the study. The alternative would drastically change the isohalines in the bay and would increase saltwater intrusion in the Lower Atchafalaya River and the Terrebonne Marsh. The alternative would also require additional locks, a control structure, and extensive dredging in Wax Lake Outlet, and was the most expensive alternative considered.

C.2.47. Increasing the percent of flow conveyed by the Lower Atchafalaya River would offer long-term advantages to flood control by enabling the Lower Atchafalaya to maintain a larger cross-sectional area. However, the immediate effects of this alternative is to increase water levels at the end of the Avoca Island levee for normal flows. Model tests on the MBM indicated that closure of the Wax Lake Outlet would raise the stage at the end of the levee by as much as 0.9 foot for a basin discharge between 100,000 cfs and 600,000 cfs. The escalation of stages would occur prior to the increased development of the channel. The extra foot of water would increase the flooding in the backwater area. For this reason the alternatives included in the plans consisted of initial construction of a weir to maintain a 70/30 distribution. As gradual development of the Lower Atchafalaya River occurs, it may be possible to further restrict Wax Lake Outlet to a 80/20 or 100/0 distribution. Since this development is highly dependent on the type of hydrograph experienced, a fixed time frame for the further restrictions cannot be developed. The channel development curves reflect the changes in distribution occurring at 10-year intervals merely as a way to illustrate the alternative.

C.2.48. Widen Wax Lake Outlet. This alternative consists of setting back the west Wax Lake Outlet levee to the location shown on Plate 9 of the main report. The existing levee would be degraded to natural ground. This would allow use of the additional overbank area during floods exceeding the 10-year frequency. The additional overbank area results in a considerable increase in conveyance capacity of the outlets during a project flood. The distribution of flow during a project flood would change from 80/20 to about 55/45 with the addition of widening the Wax Lake Outlet overbank. Comparisons of a given plan with and without the wider overbank indicated that the project flood could be reduced by about 1 foot at the end of the Avoca Island levee. Because of the increase in flow out Wax Lake Outlet, the grades for the levees west of Wax Lake Outlet are higher with the wider overbank.

FLOODING EAST OF MORGAN CITY

C.2.49. No Action. The backwater area east of Morgan City (Plate C-48) is bounded by the EABPL, Mississippi River levee, Bayou Lafourche Ridge, Lower Grand River, and Bayou Plaquemine. As discussed earlier, the area is subject to flooding caused by excessive rainfall, high tides in the gulf, and/or backwater from the Lower Atchafalaya River. While the effects of the backwater extend throughout the area, water from the Lower Atchafalaya River does not reach most of the backwater area. Water flowing around the end of the Avoca Island levee is generally confined to the area south of the GIWW and west of a line drawn from Gibson to Lake Mechant. The majority of the water reaching this area is conveyed by the Avoca Island Cutoff Bayou and Bayou Penchant. Littoral currents along the gulf coast are from east to west. These currents cause the bulk of the Atchafalaya River sediments to flow westward to East and West Cote Blanche Bay and Vermilion Bay. The freshwater and sediments flowing east of the Lower Atchafalaya River are primarily confined to the western part of the Terrebonne marshes. The area immediately adjacent to the Lower Atchafalaya River and the Atchafalaya Bay receives the largest quantities of sediment of any area of the Terrebonne marshes. This is evident from an LSU study which indicates this was the only area of the Terrebonne marshes with short term (1972-1978) gains in acreage. The remaining marshes receive freshwater and sediments from the Atchafalaya River in inverse proportion to the distance from the Atchafalaya. The area east of a line drawn from Gibson to Lake Mechant, which includes Lake Penchant and Lake de Cade, do not receive freshwater and sediment from the Atchafalaya River. Marsh loss in this area is occurring because the perfection of the levee system on the west bank of the Mississippi, including the closure of Bayou Lafourche, has severed it from replenishment and nourishment by the Mississippi flow. Marsh loss near the Houma Navigation Canal has been aggravated by saltwater intrusion resulting from the construction of the Houma Canal. Since this area does not receive freshwater or sediment from the Atchafalaya River, the marsh loss trend is expected to continue irrespective of which alternative for the backwater area is selected. As described subsequently, the flooding from rainfall and high tides is related to hydrologic events and should occur with a frequency equal to past occurrences. Flooding caused by backwater is related to the stage in the Lower Atchafalaya River at the end of the Avoca Island levee. Since the development of the Atchafalaya Bay will result in elongation of the river, and resultant escalation of the stage at the end of the levee for a given discharge, flooding caused by backwater will become more frequent and to greater depths as time progresses. The stage-frequency curves (Plates C-49 through C-54) show that the stage at Amelia, with an average return interval of 100 years, is expected to rise from 5.5 to 7.9 feet by the year 2030. Similar increases are expected to occur throughout the backwater area. The bulk of the freshwater and sediment from the Atchafalaya River which is received by the Terrebonne Marshes, is

conveyed by the Avoca Island Cutoff Bayou and Bayou Penchant. Flows leave Bayou Penchant primarily in a southern direction. The area northwest of Bayou Penchant (the Turtle Bay area) receives little sediment from the Atchafalaya River. The high short term acreage loss in this area (noted in the LSU study) was doubtless related to the high freshwater levels experienced successively in 1973, 1974, and 1975. The continuing development of the Atchafalaya Bay will also result in a continuing escalation of stages over these marshes. These higher stages could cause marsh to become open water.

C.2.50. Avoca Island Levee Extension. The Avoca Island levee was built to limit project flood stages east of Morgan City to generally the same as those that occurred in that area in the 1945 flood. However, since construction of the levee and the Bayou Boeuf closure would change the Morgan City-Amelia area from an area affected by headwater flow to one affected by backwater flow, the levee could not exactly reproduce the conditions of the 1945 flood. The 1945 flood stage at Morgan City was 6 feet in the Atchafalaya River and was about 4 feet between Morgan City and Gibson, Louisiana, and between Morgan City and Pierre Pass, Louisiana (see Plate C-48). For the project design flood discharge without the Avoca Island levee, the peak stage east of Morgan City was, in the late 1940's, computed to 4 feet. To achieve the required project flood stage east of Morgan City of 4 feet, the new levee south of Morgan City was alined parallel to the Atchafalaya River, extending a distance about 13 miles south of the city, and terminating at a flowline elevation then estimated at about 7.5 feet. The degree of protection provided by the levee varied with the location and elevation of the protected area. For all lands above elevation 4 feet, complete protection against a project flood was achieved. Lands below 4 feet, while overflowed, would be inundated to lesser depths and for shorter durations. The flood stage reductions would diminish with distance eastward away from Morgan City toward Bayou Lafourche and northward toward Bayou Sorrel lock. Since the original design, deltaic activity below Morgan City has caused the stage at the end of the Avoca Island levee to rise by about 2 feet. To preserve the improvement intended under the original design, extension of the levee by about 2.5 miles is now required to compensate for this rise. As deltaic activity continues, additional extensions totaling 14.5 miles will be required to compensate for the anticipated future increases in stage.

C.2.51. Several alinements for the total extension were considered (Plate 10 of main report). An alinement immediately adjacent to the Lower Atchafalaya River would be accompanied by extensions of the Avoca Island cutoff channel. Alinements following in the existing marsh adjacent to the shoreline or an alinement in the bay adjacent to the shoreline would require some type of navigation structure, since it would be infeasible to extend the Avoca Island cutoff channel around the levee and across the bay for each extension of the levee. The alinement adjacent to the channel and the bay-shore alinement are

shown in Plate 10 of the main report. The location of each extension was determined from projections of the development of the bay and an attempt was made to keep the end of the levee where the stage would be 7.5 feet for project design conditions. It is currently estimated that a total of six extensions will be required at approximately 10-year intervals. Exact timing and distances for future extensions will depend on the rate of development of the bay.

C.2.52. Since the Avoca Island levee extension will reduce the overbank area available for conveyance of a project flood, it will tend to cause higher project flood stages for the Lower Atchafalaya River and the lower end of the EABPL and WABPL. The alinement of the levee immediately adjacent to the channel has the most significant effect by increasing flood heights over those without the extension by up to 2 feet. However, it should be pointed out that project flood flowlines for the TS plan, which contains the Avoca Island levee extension, control of the outlets, and widening the Wax Lake Outlet overbank, are about 1.0 foot lower than the refined 1973 flowline in the Morgan City area and the lower ends of the EABPL and WABPL.

C.2.53. The marsh east of the Avoca Island levee extension depends upon freshwater and sediment from the Lower Atchafalaya River for its nourishment. To prevent the levee extension from increasing saltwater intrusion or marsh subsidence, a freshwater diversion structure is being designed as part of the extension. The structure will divert flow to maintain the present distribution of flow into the west Terrebonne Parish marsh, which is currently estimated to be 4,000 cfs. The structure will divert water into the area until the stage at Amelia, Louisiana, reaches 3.0 feet. At this point the structure will be closed for flood protection. The stage-duration curves indicated that this stage will occur less than 1 percent of the time with the levee extension. Since freshwater diversion will, on the average, be available over 99 percent of the time, there is expected to be no change in the salinity regime due to the project. The freshwater diversion structure is currently designed as eight 10 feet by 15 feet concrete culverts through the existing Avoca Island levee just above the proposed Bayou Shaffer closure. These design criteria, including the size and location of the structure, are subject to refinement during detailed design.

C.2.54. Limited Structural. Alternatives for protection of the backwater area consisted of construction of ring levees. One alternative used two ring levees to protect Morgan City - Amelia and Gibson areas (see Plate C-48 for locations). A second alternative used 28 ring levees to protect various populated areas. Construction of ring levees would provide protection for the ringed area not only from backwater flooding but also headwater and tidal flooding. The degree of protection for hurricane surges was not evaluated for this study. Since the ring levees would have no effect on flood heights outside the rings, design elevations were based on the rating curves

developed for future conditions, no action. The design grades included 2 feet of freeboard. Pumping requirements for drainage in the rings were based on a 24-hour, 25-year frequency storm. The peak sump stage for each subarea was held to 1 foot (elevation +3.0) below the elevation of the improved and populated areas. This restriction provided a safety factor for the most critical areas: that is, areas where flooding would be disastrous to both life and property. This reserve depth would provide a storage volume for protection of the area against additional flooding that might result from rainfall occurring subsequent to the design storm. The alternative consisting of two ring levees utilized a navigation structure in Bayou Chene just below Bayou Boeuf, on Bayou Boeuf just below Lake Palourde, and two on Bayou Black. These structures were to be closed when water elevations began flooding the areas. To provide for drainage of the runoff from the backwater area above Morgan City, a by-pass channel east of Bayou Boeuf would be required. This by-pass channel would have a bottom width of 300 feet with 1V on 3H side slopes and a bottom elevation of minus 20.0 feet NGVD. This channel is equivalent to the existing Bayou Boeuf.

Section 3 - DESIGN AND COST ESTIMATES

GENERAL

C.3.1. No soil borings were made specifically for this study, and no specific geologic field surveys were conducted. However, existing geology publications, general design memorandums, boring data, and other soils information from previous studies were reviewed for a better insight into geologic conditions to be encountered at the proposed and completed project sites within the floodway. A description of surface and subsurface geology is contained in Appendix A.

C.3.2. Design and cost estimates were based on experience from similar projects in the area and were developed to a level adequate to compare the various alternatives. Cost estimates are to an October 1981 price level.

DREDGE 100,000-SF CHANNEL

C.3.3. Development of the main channel through dredging as presented in the 1963 General Design Memorandum required 443,000,000 cy of dredging. Accounting for the quantity that has already been dredged and the enlargement to the natural erosive action of the river, completion of the dredged main channel would require 240,000,000 cy of dredging at an estimated cost of $230,900,000, including 15 percent contingency.

CHANNEL TRAINING

C.3.4. Channel training above Morgan City will require about 29,000,000 cy of dredging along 17.6 miles of channel. The location of dredging and increases in channel area are shown in Table C-3-1 and Plate 6 of the main report. These quantities do not include minor shaping of existing disposal areas to be accomplished by land-based equipment, which may be required during the final construction stages of the training works.

C.3.5. The levee included as part of the control of Wax Lake Outlet would replace some requirements for channel training. For plans in which channel training and control of Wax Lake Outlet were included, the channel training on the right descending bank between miles 101.5 and 104.0 was not required, thereby reducing the dredging quantity for channel training to 27,500,000 cy. The cost estimate for channel training, assuming control of Wax Lake Outlet, is shown in Table C-3-2.

TABLE C-3-1

CHANNEL TRAINING

Location (1963 Mileage)	Descending Bank	Channel Enlargement (sf)
93.7-96.0	Right	6,000
96.8-100.5	Right	12,000
101.0-101.5	Left	4,000
101.5-102.0	Left & Right	8,000
102.8-104.0	Right	4,000
104.0-105.5	Left & Right	10,000 (total)
105.5-107.0	Left	5,000
107.0-107.8	Right	4,000
107.8-108.4	Left & Right	7,000 (total)
108.8-110.4	Left & Right	7,000 (total)
113.5-116.0	Left	8,000

TABLE C-3-2

COST ESTIMATE
Channel Training Above Morgan City

Cost Account Number	Description	Estimated Quantity	Cost/Unit	Estimated Amount
			($)	($)
01	LANDS AND DAMAGES			
	Easements	6,000 AC		315,000
	Improvements			12,000
	Subtotal			327,000
	Contingencies (25% ±)			82,000
	Acquisition Cost			40,000
	Public Law 91-646			1,000
	Total 01			450,000
09	CHANNELS AND CANALS			
	Hydraulic dredging	27,500,000	1.30/CY	35,750,000
	Contingencies (25% ±)			9,250,000
	Subtotal			45,000,000
	E&D (8%)			3,500,000
	S&A (8%)			3,500,000
	Total 09			52,000,000
	TOTAL			52,450,000

C.3.6. Construction of channel training works will be accomplished by using a hydraulic dredge to pump material from the existing channel bottom areas into adjacent shallow-water bottoms or stream banks. Retaining dikes will be used for the channel training works above Morgan City. Areas selected for dredging will be those with coarser grain sizes, which will maximize natural angles of repose, thereby minimizing the areas needed for disposal. The elevation of the material will be limited to the elevation of the average annual peak stage in the area.

C.3.7. Channel training works on the Lower Atchafalaya River and Wax Lake Outlet are shown on Plate 18 of the main report. The objectives of these works would be provided in phased steps, depending upon natural deltaic activity. No retaining dikes will be used; instead the pumped material will be allowed to spread freely to the angle of repose, estimated to be 1V on 40H. Gaps will be left for pipelines and navigation access. The end result will be an irregular series of relatively low mounds of dredged material, roughly parallel to the

channels, simulating the formation of natural levees. Careful control over placement of the material will be exercised to utilize shallow water bottom adjacent to the channel rather than using existing marsh, whenever possible. In addition, every attempt will be made to avoid filling existing connecting channels. A cost estimate for channel training below Morgan City is presented in Table C-3-3. The selection of areas requiring channel training works was largely based on aerial photographs. Surveys taken for further design may indicate the development of a natural levee to an extent that precludes the requirement for channel training works.

TABLE C-3-3

COST ESTIMATE
Channel Training Below Morgan City

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	1,730 AC		577,000
	Improvements			40,000
	Subtotal			617,000
	Contingencies (25% ±)			154,000
	Acquisition Cost			60,000
	Public Law 91-646			16,000
	Total 01			847,000
09	CHANNELS AND CANALS			
	Hydraulic dredging	4,700,000	1.30/CY	6,110,000
	Closure at Bayou Shaffer (Hyd)	650,000	1.60/CY	1,040,000
	Culverts for Bayou Shaffer			304,000
	Subtotal			7,454,000
	Contingencies (25% ±)			1,849,000
	Subtotal			9,303,000
	E&D (8%)			750,000
	S&A (8%)			750,000
	Total 09			10,803,000
	TOTAL			11,650,000

C.3.8. The cost associated with channel training includes works for the main channel above Morgan City and for the outlets above the existing mouth. The requirement for channel training beyond the existing mouth is a function of the rate and extent of development of the bay, which is highly dependent upon the hydrologic events that occur in the coming years. Since the need for extending the training works will be have to be evaluated as development of the bay occurs, an estimate of cost is not included.

C.3.9. An integral part of the channel training below Morgan City is the closure of Bayou Shaffer (Plate 18 of the main report). This closure would be constructed by hydraulic means using the naturally occurring clay material in the area. No retaining dikes will be constructed for this section. The geometry of the section is based on current bed load transport theory and is larger than that required for stability. A 4-foot diameter pipe will be placed through the section at invert elevation -2.0 to accommodate some low water flows. The crown portion of the hydraulically placed closure section will be shaped after the initial fill has been in place for about 3 years. The shape-up will be in two stages, consisting of an initial dragline shaping and a final dragline shaping about 1 year later. Based on boring data in the area, it is estimated that about 10 feet of settlement can be expected for the closure. The cost estimate for the closure of Bayou Shaffer is included in Table C-3-3.

DISTRIBUTARY REALINEMENT

C.3.10. Realinement of the four major distributaries of the main channel would be accomplished as shown on Plate 7 of the main report, to the dimensions shown in Table C-3-4. Disposal of the dredged material will be in the main channel except for the Atchafalaya River at the Whiskey Bay Pilot Channel realinement for which the material will be placed on land disposal areas. Closure of the existing distribution channels will be accomplished during the final stages of dredging the realined channel by disposal into the existing channel. Channel revetment of each realined channel will be required. The cost estimate for distributary realinement is presented in Table C-3-5.

SEDIMENT TRAPS

C.3.11. Sediment traps would be constructed at each of the four major distributaries near the channel realinements shown on Plate 7 of the main report. Table C-3-6 shows dimensions and initial and maintenance dredging requirements for each sediment trap. Disposal of this dredged material will be on land disposal areas alined parallel to the main channel. The material will be placed to a depth of 20 feet over

TABLE C-3-4

CHANNEL REALINEMENT

Distributary	Length (ft)	Width (ft)	Bottom Elevation (ft NGVD)	Side Slopes	Excavation Required (cy)
Atchafalaya River at WBPC	6,000	1,000 (top)	-15.0	1:3	3,500,000
West Access	8,000	60	-7.0 (bottom)	1:3	350,000
East Fresh-water	13,000	105	-7.0 (bottom)	1:3	800,000
East Access	15,000	60	-7.0 (bottom)	1:3	650,000

TABLE C-3-5

COST ESTIMATE
Channel Realinement

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	752 AC		302,500
	Improvements			23,500
	Subtotal			326,000
	Contingencies (25%±)			82,000
	Acquisition Cost			20,000
	Public Law 91-646			3,000
	Total 01			431,000
09	CHANNELS AND CANALS			
	Channel Realinement			
	Atchafalaya River at WBPC			
	Mob, Demob			115,000
	Clearing, Grubbing	600	1,700/AC	1,020,000
	Retaining Dikes	160,000	3.50/CY	560,000
	Hyd. Excavation	3,500,000	1.40/CY	4,900,000
	Subtotal			6,595,000

TABLE C-3-5 (Continued)

COST ESTIMATE
Channel Realinement

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
	West Access			
	Mob, Demob			115,000
	Clearing, Grubbing	30	1,700/AC	51,000
	Hyd. Excavation	350,000	1.40/CY	490,000
	Subtotal			656,000
	East Freshwater			
	Mob, Demob			115,000
	Clearing, Grubbing	60	1,700/AC	102,000
	Hyd. Excavation	800,000	1.40/CY	1,120,000
	Subtotal			1,337,000
	East Access			
	Mob, Demob			115,000
	Clearing, Grubbing	60	1,700/AC	102,000
	Hyd. Excavation	650,000	1.40/CY	912,000
	Subtotal			1,127,000
	Subtotal 09			9,715,000
	Contingencies (25% ±)			2,326,000
	Subtotal			12,041,000
	E&D (8%)			914,000
	S&A (8%)			914,000
	Total 09			13,869,000
16	BANK STABILIZATION (ACM)			
	Channel Realinement			
	West Access	6,000	LS/SQ	2,900,000
	East Freshwater	8,000	LS/SQ	3,800,000
	East Access	10,000	LS/SQ	4,800,000
	Subtotal			11,500,000
	Contingencies (25% ±)			2,900,000
	Subtotal			14,400,000
	E&D (8%)			1,200,000
	S&A (8%)			1,200,000
	Total 16			16,800,000
	TOTAL			31,100,000

TABLE C-3-6

SEDIMENT TRAPS

Trap	Length (ft)	Width (ft)	Bottom Elevation (ft NGVD)	Initial Excavation (cy)	Annual Maintenance (cy)	Disposal Area (acres)
Atchafalaya River at WBPL	2,500	1,400	-40.0	4,000,000	1,900,000	3,000
West Access	1,000	300	-13.0	180,000	57,000	90
East Freshwater	1,000	400	-13.0	260,000	90,000	150
East Access	1,250	400	-12.0	307,000	80,000	165

the project life. The initial construction of the sediment traps would cost about $12,800,000 including contingencies, E&D, and S&A.

CONTROL OUTLET DISTRIBUTION

C.3.12. The 70/30 control weir will consist of a two-stage stone weir placed at the head of Cypress Island with tie-in levees to the WABPL at Taylor's Point and on the downstream at Stout's Light. The upper tie-in levee from Taylor's Point will be at the same grade as the WABPL with a 20-foot crown, IV on 4H side slopes, and berms as required. This tie-in levee will carry the access road. The lower tie-in levee will start at the weir at elevation +10.1 and tie into the grade of the WABPL at Stout's Light. This levee will also have a 20-foot crown to provide access to the weir, 1V on 4H side slopes, and berms as required. Table C-3-7 contains the cost estimate for the 70/30 control weir and tie-in levees.

C.3.13. Soil boring data in the vicinity of the proposed alinement of the levee indicate recent fat clays of very soft to medium consistency from ground surface to about 50 feet depth, underlain by lean clays and silts to a depth of about 80 feet. The lean clays are underlain by about 40 feet of medium consistency fat clays over substratum sands at a depth of about 120 feet. Settlement of about 2.5 feet is expected for the center of the 70/30 weir, 4.0 feet for the outer sections, and 2.0 feet for the tie-in levees.

C.3.14. The 100/0 control of Wax Lake Outlet would be similar in section to the tie-in levee described previously. The overflow portions would be rip-rapped as required to minimize scour. The cost estimate for the 100/0 control is shown in Table C-3-8.

C.3.15. Control of Wax Lake Outlet to a 80/20 distribution requires the construction of a gated control structure. The control would consist of a control structure and overtopping weir, flanked by an overtopping spoil levee. The control structure would consist of five tainter gated bays, each 60 feet wide. Bottom sill elevation on the control structure would be -10.0. The control structure would be flanked by and overtopping rip-rap weir crest elevation of 5.0 feet, approximately 2,850 feet in length. A continuous spoil levee connecting the closure to the WABPL would remain as discussed in the 30 percent distribution. A 48-inch-thick rip-rap blanket would extend 50 feet upstream and 100 feet downstream of the weir and control structure. This control would cost about $33,100,000 including contingencies E&D and S&A.

TABLE C-3-7

COST ESTIMATE
Outlet Control
70/30 Distribution

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS			
	Easements	300 AC		14,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			12,000
	Total 01			30,000
02	RELOCATIONS			
	CLECO 13.2 KV Powerline			2,100
	Exxon Pipeline 8"ϕ			22,100
	22"ϕ			61,400
	Southern Natural Gas	4-4"ϕ		45,200
		20"ϕ		55,700
		30"ϕ		83,600
	Cockrell Oil Co.	4"ϕ		11,300
		30"ϕ		83,600
	Subtotal			365,000
	Contingencies (25% ±)			91,000
	Subtotal			456,000
	E&D (6%)			27,000
	S&A (6%)			27,000
	Total 02			510,000
11	LEVEES AND FLOODWALLS			
	Earth Embankment	255,000	2.30/CY	586,500
	Rock Fill	347,000	17.30/TN	6,003,100
	Clearing & Grubbing	300	1,700/AC	510,000
	Subtotal			7,099,600
	Contingencies (25% ±)			1,770,400
	Subtotal			8,870,000
	E&D (8%)			710,000
	S&A (8%)			710,000
	Total 11			10,290,000
	TOTAL			10,830,000

TABLE C-3-8

COST ESTIMATE
Outlet Control
100/0 Distribution

Cost Account Number	Description	Estimated Quantity	Cost/Unit	Estimated Amount
			($)	($)
01	LANDS AND DAMAGES			
	Easements	470 AC		16,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			16,000
	Total 01			36,000
02	RELOCATIONS			
	CLECO 13.2 KV Powerline			2,100
	Exxon Pipeline Co.	8"ϕ		21,700
		22"ϕ		61,400
	Southern Natural Gas	4-4"ϕ		45,200
		20"ϕ		55,700
		30"ϕ		83,600
	Cockrell Oil Co.	4"ϕ		11,300
	United Gas Co.	30"ϕ		83,600
	Subtotal			364,600
	Contingencies (25% ±)			91,400
	Subtotal			456,000
	E&D (6%)			27,000
	S&A (6%)			27,000
	Total 02			510,000
11	LEVEES AND FLOODWALLS			
	Cypress Island Levee	1,300,000	2.30/CY	2,990,000
	Clearing & Grubbing	390	1,700/AC	663,000
	Tie-in Levee and Rock Closure			
	Earth Embankment (cast)	325,000	2.30/CY	747,500
	Earth Embankment (hyd)	235,000	3.50/CY	822,500
	Rock Fill	467,000	17.30/TN	8,079,100
	Clearing & Grubbing	60	1,700/AC	102,000
	Subtotal			13,404,100
	Contingencies (25% ±)			3,355,900
	Subtotal 11			16,760,000
	E&D (8%)			1,347,000
	S&A (8%)			1,347,000
	Total 11			19,454,000
	TOTAL			20,000,000

INCREASED SEDIMENT DIVERSION THROUGH WAX LAKE OUTLET

C.3.16. Increased sediment diversion through Wax Lake Outlet would consist of construction of a new channel between the Atchafalaya River and Wax Lake Outlet and closure of the existing connection (Plate 12 of the main report). The new channel would be constructed to maximize sediment diversion. The cost of this feature was estimated to be the same as the 70/30 control weir, with an additional $21,000,000 for construction of the new channel (Table C-3-9).

WIDEN WAX LAKE OUTLET OVERBANK

C.3.17. Widening the Wax Lake Outlet overbank would require construction of 8.0 miles of new levee from near Shadyside, Louisiana, to the GIWW just east of the Wax Lake west pumping station (Plate 9 of the main report). Degradation of the existing 9.3 miles of levee to natural ground will also be required. Relocation of US Highway 90, old US Highway 90, St. Mary Parish Road levee crossing, Southern Pacific railroad, 32 gas and power lines, and the West Calumet floodgate will also be required. Table C-3-10 shows the cost estimate for this feature.

AVOCA ISLAND LEVEE EXTENSION

C.3.18. General. Cost estimates for the bay-shore alinement and the alinement adjacent to the channel are shown in Tables C-3-11 and C-3-12, respectively. Each alinement consists of six extensions over the next 50 years (Table C-3-13). The date for each extension was based on projection of the delta development. The actual construction of each extension is dependent on the actual rate of development of the delta and will have to be evaluated as development takes place.

C.3.19. Soil Conditions. Soil boring data are available for the first extension, which is common to both alinements. The foundation conditions for this extension were derived from these borings. Since data were not available for the remaining extensions and because of the deferred construction timetable, foundation conditions for extensions 2 through 6 were assumed to be the same as that for the first extension.

C.3.20. A generalized soil profile shows the subsurface consists of recent deposits of very soft to medium clay soils, with peat and silt layers. The upper 20 to 30 feet are recent marsh deposits consisting of very soft organic clays and peat, both with very high moisture contents. The recent marsh deposits are underlain by older marsh deposits to a depth of about 60 feet, consisting generally of very soft to medium clays with organic material.

TABLE C-3-9

COST ESTIMATE
Increase Sediment Through WLO

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easement	400 AC		16,000
	Contingencies (25% ±)			4,000
	Acquisition Cost			16,000
	Total 01			36,000
09	CHANNELS AND CANALS			
	Mob & Demob			115,000
	Excavation (hyd)	10,400,000	1.40/CY	14,560,000
	Subtotal			14,675,000
	Contingencies (25% ±)			3,689,000
	Subtotal			18,364,000
	E&D (8%)			1,450,000
	S&A (8%)			1,450,000
	Total 09			21,264,000
	TOTAL			21,300,000

TABLE C-3-10

COST ESTIMATE
Widen Wax Lake Outlet

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES			
	Easements	10,345 AC		5,495,000
	Improvements			624,000
	Severence			60,000
	Sugarcane Crop Damage (stubble)			150,000
	Cemetery Relocation			12,000
	Subtotal			6,341,000
	Contingencies (25% ±)			1,585,000
	Acquisition Cost			300,000
	Public Law 91-646			322,000
	Total 01			8,548,000
02	RELOCATIONS			
	Westside Approach US Hwy 90, 4-lane			258,000
	US Hwy 90 Elevated 4-lane			19,726,000
	Old US Hwy 90 Levee Crossing			86,000
	St. Mary Parish Road Levee Crossing			86,000
	Southern Pacific Elevated Track			7,105,000
	Southern Pacific Approaches			73,000
	Southern Pacific Removal of Old Track			66,000
	Southern Pacific R/W			451,000
	Trunkline Gas Co. 2-30"ϕ			412,000
	Texas Gas Transmission Co. 2-20"ϕ			275,000
	LA Intrastate Gas 2-8"ϕ			109,000
	Promix Corp 2-8"ϕ			109,000
	Wanda Petroleum 4-8"ϕ			218,000
	Columbia Gulf 2-20"ϕ			275,000
	2-30"ϕ			412,000
	Southern Natural Gas Co. 6"ϕ			55,000
	Degrade WABPL 6"ϕ			29,000
	Michigan - Wisconsin Pipeline Co. 20"ϕ			183,000
	Degrade WABPL 20"ϕ			92,000
	Placid Oil Co. 6"ϕ			55,000
	Degrade WABPL 6"ϕ			29,000
	4 - 34.5 KV Powerlines			34,000
	2 - 100 pair telephone cables			9,000
	Southern Natural Gas Co. 2-12"ϕ			83,000
	United Gas Pipeline Co. 2-26"ϕ			179,000
	Subtotal			30,409,000

TABLE C-3-10 (Continued)

COST ESTIMATE
Widen Wax Lake Outlet

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
	Contingencies (25% ±)			7,601,000
	Subtotal			38,010,000
	E&D (6%)			2,280,000
	S&A (6%)			2,280,000
	Total 02			42,570,000
11	LEVEES AND FLOODWALLS			
	Realined levee	2,500,000	3.50/CY	8,750,000
	Clearing & Grubbing	550	1,700/AC	935,000
	Degrade levee	1,714,000	1.70/CY	2,913,800
	Clearing & Grubbing	780	1,700/AC	1,326,000
	West Calumet Floodgate			13,200,000
	Subtotal			27,124,800
	Contingencies (25% ±)			6,785,200
	Subtotal			33,910,000
	E&D (8%)			2,736,000
	S&A (8%)			2,736,000
	Total 11			39,382,000
	TOTAL			90,500,000

TABLE C-3-11

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Station 680+00 to Station 1714+00
Bay-Shore Alinement

Reach 1	-------	Station 680+00 - 817+00
Reach 2	-------	Station 817+00 - 997+00
Reach 3	-------	Station 997+00 - 1267+00
Reach 4	-------	Station 1267+00 - 1420+00
Reach 5	-------	Station 1420+00 - 1568+00
Reach 6	-------	Station 1568+00 - 1714+00

SUMMARY

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	132,000
	Contingencies (25% ±)	33,000
	Acquisition Cost	12,000
	Total 01	177,000
02	RELOCATIONS	4,356,000
	Contingencies (25% ±)	1,087,000
	Total 02	5,443,000
06	FISH AND WILDLIFE FACILITIES	86,051,000
	Contingencies (25% ±)	21,519,000
	Total 15	107,570,000
11	LEVEES AND FLOODWALLS	177,173,000
	Contingencies (25% ±)	44,297,000
	Total 11	221,470,000
30	ENGINEERING AND DESIGN	26,820,000
31	SUPERVISION AND ADMINISTRATION	26,820,000
	TOTAL	388,300,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
1986 Start	1st Lift	6,998,000
1988 End	Retaining Dikes	1,220,000
1st Contract	Waste Dikes	233,000
1st Reach	Relocations	2,334,000
	Lands and Damages (660 acres)	132,000
	Waste Excavation	4,535,000
	Closure of AICO	5,444,000
	Diversion Structure	5,137,000
	Subtotal	26,033,000
	Contingencies (25% ±)	6,505,000
	Subtotal	32,538,000
	E&D/S&A (16%)	5,200,000
	Acquisition Cost	12,000
	Total	37,750,000
1990 Start	1st Lift	8,841,000
1993 End	Dikes	1,233,000
1st Contract	Waste Dikes	301,000
2nd Reach	Waste Excavation	5,977,000
	Lands and Damages (887 acres)	0
	Relocations	297,000
	Inflatable dam	80,914,000
	Subtotal	97,563,000
	Contingencies (25% ±)	24,387,000
	Subtotal	121,950,000
	E&D/S&A (16%)	19,550,000
	Total	141,500,000
1991 Start	2nd Lift	6,085,000
1992 End	Retaining Dikes	686,000
2nd Contract	Subtotal	6,771,000
1st Reach	Contingencies (25% ±)	1,699,000
	Subtotal	8,470,000
	E&D/S&A (16%)	1,350,000
	Total	9,820,000
1995 Start	3rd Lift	6,239,000
1996 End	Retaining Dikes	546,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
3rd Contract	2nd Lift	8,059,000
1st Reach	Retaining Dikes	908,000
2nd Contract	Subtotal	15,752,000
2nd Reach	Contingencies (25% ±)	3,938,000
	Subtotal	19,690,000
	E&D/S&A (16%)	3,150,000
	Total	22,840,000
1999 Start	3rd Lift	4,633,000
2003 End	Retaining Dikes	594,000
3rd Contract	1st Lift	13,242,000
2nd Reach	Dikes	1,846,000
1st Contract	Waste Dikes	450,000
3rd Reach	Waste Excavation	8,952,000
	Lands & Damages (1,333 acres)	0
	Subtotal	29,717,000
	Contingencies (25% ±)	7,423,000
	Subtotal	37,140,000
	E&D/S&A (16%)	5,950,000
	Total	43,090,000
2001 Start	Shape-Up	332,000
2002 End	Fert/Seed	69,000
4th Contract	Subtotal	401,000
1st Reach	Contingencies (25% ±)	100,000
	Subtotal	501,000
	E&D/S&A (16%)	80,000
	Total	581,000
2006 Start	Shape-Up	443,000
2007 End	Fert/Seed	73,000
4th Contract	2nd Lift	12,070,000
2nd Reach	Retaining Dikes	1,362,000
2nd Contract	Subtotal	13,948,000
3rd Reach	Contingencies (25% ±)	3,452,000
	Subtotal	17,400,000
	E&D/S&A (16%)	2,800,000
	Total	20,200,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
2010 Start	3rd Lift	6,939,000
2014 End	Retaining Dikes	890,000
3rd Contract	1st Lift	7,493,000
3rd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
4th Reach	Waste Excavation	5,066,000
	Lands and Damages (754 acres)	0
	Relocations	1,725,000
	Subtotal	23,413,000
	Contingencies (25% ±)	5,837,000
	Subtotal	29,250,000
	E&D/S&A (16%)	4,700,000
	Total	33,950,000
2016 Start	Shape-Up	664,000
2017 End	Fert/Seed	109,000
4th Contract	2nd Lift	6,830,000
3rd Reach	Retaining Dikes	771,000
2nd Contract	Subtotal	8,374,000
4th Reach	Contingencies (25% ±)	2,126,000
	Subtotal	10,500,000
	E&D/S&A (16%)	1,700,000
	Total	12,200,000
2020 Start	3rd Lift	3,926,000
2024 End	Retaining Dikes	504,000
3rd Contract	1st Lift	7,250,000
4th Reach	Dikes	745,000
1st Contract	Waste Dikes	247,000
5th Reach	Waste Excavation	4,900,000
	Lands and Damages (704 acres)	0
	Subtotal	17,572,000
	Contingencies (25% ±)	4,428,000
	Subtotal	22,000,000
	E&D/S&A (16%)	3,500,000
	Total	25,500,000
2026 Start	Shape-Up	139,000
2027 End	Fert/Seed	54,000

TABLE C-3-11 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Bay-Shore Alinement

Year	Item of Work	Estimated Amount ($)
4th Contract	2nd Lift	6,603,000
4th Reach	Dikes	487,000
2nd Contract	Subtotal	7,283,000
5th Reach	Contingencies (25% ±)	1,817,000
	Subtotal	9,100,000
	E&D/S&A (16%)	1,500,000
	Total	10,600,000
2030 Start	Shape-Up	549,000
2033 End	Fert/Seed	51,000
3rd Contract	1st Lift	7,151,000
5th Reach	Retaining Dikes	736,000
1st Contract	Waste Dikes	244,000
6th Reach	Waste Excavation	4,834,000
	Lands and Damages	0
	Subtotal	13,565,000
	Contingencies (25% ±)	3,435,000
	Subtotal	17,000,000
	E&D/S&A (16%)	2,700,000
	Total	19,700,000
2036 Start	1st Lift	6,514,000
2037 End	Retaining Dikes	480,000
2nd Contract	Subtotal	6,994,000
6th Reach	Contingencies (25% ±)	1,706,000
	Subtotal	8,700,000
	E&D/S&A (16%)	1,400,000
	Total	10,100,000
2040 Start	Shape-Up	283,000
2041 End	Fert/Seed	43,000
3rd Contract	Subtotal	326,000
6th Reach	Contingencies (25% ±)	83,000
	Subtotal	409,000
	E&D/S&A (16%)	60,000
	Total	469,000
	TOTAL COST	388,300,000

TABLE C-3-12

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Station 680+00 to Station 1580+00
Adjacent to Channel Alinement

Reach 1 ------- Station 680+00 - 817+00
Reach 2 ------- Station 817+00 - 970+00
Reach 3 ------- Station 970+00 - 1123+00
Reach 4 ------- Station 1123+00 - 1276+00
Reach 5 ------- Station 1276+00 - 1429+00
Reach 6 ------- Station 1429+00 - 1580+00

SUMMARY

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	132,000
	Contingencies (25% ±)	33,000
	Acquisition Cost	12,000
	Total 01	177,000
02	RELOCATIONS	3,225,000
	Contingencies (25% ±)	804,000
	Total 02	4,029,000
06	FISH AND WILDLIFE FACILITIES	5,137,000
	Contingencies (25% ±)	1,283,000
	Total 15	6,420,000
11	LEVEES AND FLOODWALLS	178,876,000
	Contingencies (25% ±)	44,714,000
	Total 11	223,590,000
30	ENGINEERING AND DESIGN	18,732,000
31	SUPERVISION AND ADMINISTRATION	18,732,000
	TOTAL	271,680,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
1986 Start	1st Lift	6,998,000
1988 End	Retaining Dikes	1,220,000
1st Contract	Waste Dikes	233,000
1st Reach	Relocations	2,334,000
	Lands and Damages (660 acres)	132,000
	Waste Excavation	4,535,000
	Diversion Structure	5,137,000
	Closure of AICO	5,444,000
	Subtotal	26,033,000
	Contingencies (25% ±)	6,505,000
	Subtotal	32,538,000
	E&D (8%)	2,600,000
	S&A (8%)	2,600,000
	Acquisition Cost	12,000
	Total	37,750,000
1990 Start	1st Lift	6,811,000
1993 End	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
2nd Reach	Waste Excavation	5,066,000
	Lands and Damages (752 acres)	0
	Relocations	297,000
	Closure	6,807,000
	Subtotal	20,281,000
	Contingencies (25% ±)	5,069,000
	Subtotal	25,350,000
	E&D/S&A (16%)	4,060,000
	Total	29,410,000
1991 Start	2nd Lift	5,482,000
1992 End	Retaining Dikes	686,000
2nd Contract	Subtotal	6,168,000
1st Reach	Contingencies (25% ±)	1,542,000
	Subtotal	7,710,000
	E&D/S&A (16%)	1,230,000
	Total	8,940,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
1995 Start	3rd Lift	5,621,000
1996 End	Retaining Dikes	546,000
3rd Contract	2nd Lift	6,209,000
1st Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	13,146,000
2nd Reach	Contingencies (25% ±)	3,284,000
	Subtotal	16,430,000
	E&D/S&A (16%)	2,630,000
	Total	19,060,000
1999 Start	3rd Lift	3,569,000
2003 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,811,000
2nd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
3rd Reach	Waste Excavation	5,066,000
	Lands and Damages (754 acres)	0
	Relocations	297,000
	Closure	6,805,000
	Subtotal	24,352,000
	Contingencies (25% ±)	6,088,000
	Subtotal	30,440,000
	E&D/S&A (16%)	4,870,000
	Total	35,310,000
2001 Start	Shape-Up	332,000
2002 End	Fert/Seed	69,000
4th Contract	Subtotal	401,000
1st Reach	Contingencies (25% ±)	100,000
	Subtotal	501,000
	E&D/S&A (16%)	79,000
	Total	580,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2006 Start	Shape-Up	376,000
2007 End	Fert/Seed	62,000
4th Contract	2nd Lift	6,209,000
2nd Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	7,417,000
3rd Reach	Contingencies (25% ±)	1,853,000
	Subtotal	9,270,000
	E&D/S&A (16%)	1,480,000
	Total	10,750,000
2010 Start	3rd Lift	3,569,000
2014 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,811,000
3rd Reach	Dikes	1,045,000
1st Contract	Waste Dikes	255,000
4th Reach	Waste Excavation	5,066,000
	Lands and Damages (732 acres)	0
	Relocations	297,000
	Closure	6,805,000
	Subtotal	24,352,000
	Contingencies (25%±)	6,088,000
	Subtotal	30,440,000
	E&D/S&A (16%)	4,870,000
	Total	35,310,000
2016 Start	Shape-Up	376,000
2017 End	Fert/Seed	62,000
4th Contract	2nd Lift	6,209,000
3rd Reach	Retaining Dikes	770,000
2nd Contract	Subtotal	7,417,000
4th Reach	Contingencies (25%±)	1,853,000
	Subtotal	9,270,000
	E&D/S&A (16%)	1,480,000
	Total	10,750,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2020 Start	3rd Lift	3,569,000
2024 End	Retaining Dikes	504,000
3rd Contract	1st Lift	6,814,000
4th Reach	Dikes	770,000
1st Contract	Waste Dikes	255,000
5th Reach	Waste Excavation	5,066,000
	Lands and Damages (728 acres)	0
	Closure	6,805,000
	Subtotal	23,783,000
	Contingencies (25% ±)	5,947,000
	Subtotal	29,730,000
	E&D/S&A (16%)	4,760,000
	Total	34,490,000
2026 Start	Shape-Up	139,000
2027 End	Fert/Seed	54,000
4th Contract	2nd Lift	6,205,000
4th Reach	Dikes	504,000
2nd Contract	Subtotal	6,902,000
5th Reach	Contingencies (25% ±)	1,728,000
	Subtotal	8,630,000
	E&D/S&A (16%)	1,380,000
	Total	10,010,000
2030 Start	Shape-Up	568,000
2033 End	Fert/Seed	53,000
3rd Contract	1st Lift	6,723,000
5th Reach	Retaining Dikes	761,000
1st Contract	Waste Dikes	252,000
6th Reach	Waste Excavation	4,999,000
	Closure	6,805,000
	Lands and Damages (695 acres)	0
	Subtotal	20,161,000
	Contingencies (25% ±)	5,039,000
	Subtotal	25,200,000
	E&D/S&A (16%)	4,030,000
	Total	29,230,000

TABLE C-3-12 (Continued)

COST ESTIMATE
AVOCA ISLAND LEVEE EXTENSION
Adjacent to Channel Alinement

Year	Item of Work	Estimated Amount ($)
2036 Start	1st Lift	6,124,000
2037 End	Dikes (Retaining)	496,000
2nd Contract	Subtotal	6,620,000
6th Reach	Contingencies (25% ±)	1,655,000
	Subtotal	8,275,000
	E&D/S&A (16%)	1,325,000
	Total	9,600,000
2040 Start	Shape-Up	292,000
2041 End	Fert/Seed	45,000
3rd Contract	Subtotal	337,000
6th Reach	Contingencies (25% ±)	83,000
	Subtotal	420,000
	E&D/S&A (16%)	70,000
	Total	490,000
	TOTAL COST	271,680,000

TABLE C-3-13

AVOCA ISLAND LEVEE EXTENSION

Extension Number	Year of 1st Lift	Adjacent to Channel Levee Station Begin	Adjacent to Channel Levee Station End	Bay Shore Levee Station Begin	Bay Shore Levee Station End
1	1986	680+00	817+00	680+00	817+00
2	1990	817+00	970+00	817+00	997+00
3	1999	970+00	1123+00	997+00	1267+00
4	2010	1123+00	1267+00	1267+00	1420+00
5	2020	1267+00	1429+00	1420+00	1568+00
6	2030	1429+00	1580+00	1568+00	1714+00

C.3.21. Methods of Construction. The levee will be built by stage construction over a period of several years. The hydraulic clay fill will be obtained from the channel relocation area and will be pumped in three lifts with approximately 3-year intervals between succesive lifts, followed by an initial and final shape-up. The first lift will have a crown elevation of 10.0 with 1V on 40H slopes tieing into the retention dikes at an elevation not higher than 3 feet below the dike crown. Approximately 3 years after the final pumping, the levee will be shaped by dragline. One year after initial shape-up, a final dragline shape-up with an allowable overbuild for future settlement will be accomplished.

C.3.22. The dikes will be constructed with cast fill from interior borrow pits. Sufficient material will be stockpiled in the form of a berm adjacent to the riverside (west) levee retention dike to permit raising of the dike to compensate for settlement during the first lift construction. Pipeline canals and natural bayous will be closed with clay-faced shell closures. Before any levee work begins, the pipelines will be relocated on temporary pile bents to conform to the final levee section. After completion of the levee, all piling and supports must be either driven down or broken off to a minimum depth of 8 feet below the surface of the theoretical design section. Openings will be provided in the riverside retention dike and in the landside channel waste dike on about 1,000-foot centers to allow the hydraulic effluent to exit. The hydraulic effluent from the first lift section will be allowed to flow over the marsh into the Lower Atchafalaya River, thereby enhancing the marsh. The openings through the waste dike will allow the hydraulic effluent to run back into the channel being constructed. The dike openings will be constructed using standard variable-head spill boxes.

C.3.23. The channel relocation-borrow fill will be stripped and all material above elevation minus 15.0 will be wasted. The waste material will be placed in an area adjacent to the first lift levee fill. The channel side waste dike is to be constructed with cast fill from an interior borrow pit. A working berm of 40 feet from the dike toe to the top of cut will be maintained. The back channel waste dike will also be used as the landside retention dike for the first lift levee construction. The hydraulic clay borrow will be taken from material below elevation minus 15.0.

C.3.24. Stability Analysis. Stability of the hydraulic fill first lift sections were determined using cross sections and (Q) sheer strengths representative of the existing conditions along the levee alinement. The maximum allowable first lift section was developed, based on the method of planes and a minimum safety factor of 1.30. The levee retention dikes were located so that they would form the berm toe for the final levee section. The retention dikes were designed for minimum safety factors of 1.20 for the temporary condition of interior borrow with no hydraulic levee fill in place, and 1.30 for

the condition of hydraulic levee fill placed within 3 feet of the dike crown and hydraulic effluent to the top of the dikes.

C.3.25. Shell Closure Retention Dikes. Two types of shell closure dikes, designed to be used across bayou and oil company canals, have the following range of depths: elevation 0 to minus 3; minus 3 to minus 6; and minus 6 to minus 9. The dikes will be used along the riverside (west) dike alinement. The landside (east) dike, which will have fill on both sides, will be made up of shell with clay facing on both sides. The dike section will be formed by constructing the eastern (fill side) symmetrically about the dike centerline. The closure dikes were designed for a minimum safety factor of 1.30, considering hydraulic fill to within 3 feet of the top of dike. Check analyses considering hydraulic effluent to the top of the dikes were made and resulted in no significant change in safety factors. Stability analyses were also performed with no fill in place for an assumed failure in the fill area.

C.3.26. Channel Waste Dike. The channel waste dike was designed for a minimum safety factor of 1.30 within itself and a minimum safety factor of 1.50 into the channel relocation borrow pit. Designs were based on the condition of spoil to within 3 feet of the top of the dikes and hydraulic effluent to the top of the dikes. A 40-foot minimum work area was maintained between the top of cut and toe of dike.

C.3.27. Navigation channel. The channel section will be constructed with 1V on 3.5H side slopes to elevation minus 20.0 (with 2 feet of future maintenance depth). Stability analyses of the channel slopes were performed for a minimum safety factor of 1.50. The channel for the alinement adjacent to the river will be constructed incident to the levee construction (as borrow), and no additional costs are anticipated.

C.3.28. The bay-shore alinement will require some type of navigation structure because it would be impractical to relocate the navigation channel around the end of the levee and across the eastern bay to the Lower Atchafalaya River for each extension. Since navigation in the Avoca Island channel requires 400 feet of width, the structure is beyond the scope of a conventional structure. The estimate shown in Table C-3-11, includes a cost for an inflatable dam across the navigation channel after the first extension. The inflatable dam consists of a rubberized fabric, which is anchored to the channel bottom. When the stages in the Lower Atchafalay River begin to cause backwater problems, the dam would be inflated with water, creating a barrier equal to the levee in protection.

C.3.29. While inflatable dams have been used in various locations around the world, little information has been available to determine their workability for this project. Extensive investigations will have to be undertaken prior to final determination of its use in the

Avoca Island levee extension. The cost estimate, shown in Table C-3-11, for the dam was based on assuming construction of the dam would require dewatering the construction site and excavation of a bypass channel.

C.3.30. Freshwater Diversion Structure. The freshwater diversion structure will be pile supported and constructed in the dry behind cofferdams. The structure is currently designed as eight 10- by 15-foot concrete culverts through the existing Avoca Island levee. The inflow and outflow channels will be constructed after the structure is complete, backfilled, and with the erosion protection in place. Cost for the structure is shown in Tables C-3-11 and C-3-12.

C.3.31. Floodwall Construction. Consideration was given to utilizing floodwall construction to produce favorable economics in constructing the Avoca Island levee extension. The first attempt consisted of an I-wall driven into a levee with a crown elevation low enough to utilize cast-fill construction. A slope stability analysis resulted in a levee cross section with small berms and borrow areas close enough to utilize castfill construction without double handling the fill material. However, cantilever retaining wall analyses indicate required sheetpile lengths of 82.5 and 86.5 feet for the two reaches.

C.3.32. For a second design attempt, a sheetpile length of 40 feet was determined to be the maximum which might be driven in the existing terrain. Preliminary cantilever retaining wall analyses indicate the required crown elevations of the levees would require large berms and would extend the safe limits of the available borrow areas beyond the distance which could be singly handled by cast-fill construction methods. It is anticipated that hydraulic-construction will be utilized and the first lift sections would be identical to that used for the all-earthen levee. Two lifts are anticipated, 3 years apart, with a shape-up 3 years after the second lift. Cost estimates indicated use of an I-wall would cost about $81,600,000 more than an all-earthen levee for the six extensions.

LIMITED STRUCTURAL

C.3.33. Two alternatives utilizing ring levees in the backwater area were investigated. The alternative consisted of two ring levees around the Morgan City-Amelia area and the Bayou Black-Gibson area. These two rings utilized inflatable dams in Bayou Boeuf and Bayou Black. The total construction costs for the two rings is $420,000,000. The second alternative consisted of 28 ring levees throughout the area. Location of the rings avoided the use of navigation structures. The total construction cost for the 28-ring levee alternative is $391,000,000.

C.3.34. The estimate for the ring levees alternative includes those first costs for levee, floodwall and pumping station construction, lands and damages, and relocations. Floodproofing of structures outside the ring levees is not included. The cost includes collapsible floodwalls in the industrial areas of Morgan City and Amelia. Use of a collapsible floodwall for flood protection is not desirable from an operational standpoint. Since this is a survey scope estimate, a complete investigation of the details of such a wall has not been made. However, there is concern of its practicality in two particular areas. In its down position the wall will be crossed by heavy industrial traffic and may be subject to damages and, therefore, not operable when it is needed. To maintain the appropriate freeboard, it would be necessary to raise the floodwalls prior to a stage of 3 feet. Since stages in this area are affected by tides, there would be little or no advance notice as to the requirement to raise the floodwall; therefore, it will be necessary to construct a wall which can be raised very quickly.

MANAGEMENT UNITS

C.3.35. The cost estimates presented in Tables C-3-14 through C-3-18 are for the five management units being recommended for further consideration. The levee costs are based on levees with 1V on 3H side slopes constructed by adjacent casting. Existing ground surface elevations in the area of the proposed levee were extracted from contour maps and hydrographic surveys. The height of the levees were determined from the average annual peak flowline at the location of the proposed levee.

C.3.36. Construction of levees for the management units would be limited to a portion of the total circumference of the units, since the existing ground for the remaining portions equals or exceeds the levee height requirement. For the Flat Lake unit levee, construction would take place only along the southern and southwestern boundaries. Construction for Buffalo Cove would take place along the southern half of the western boundary and closing at low spots for the remaining boundary. Beau Bayou's construction would primarily be closing at low spots in its existing levees. No initial levee construction is anticipated for Henderson and Cocodrie Swamps.

C.3.37. The inlet for the Henderson Unit would be the proposed Courtableau freshwater structure and the existing drainage structures. Extensive channel work would be required for the freshwater structure. The costs for the channel work are presented in Table C-3-14, and the freshwater structure costs are shown in Table C-3-19.

TABLE C-3-14

COST ESTIMATE
Henderson Management Unit

Cost Account Number	Description	Quantity	Estimated Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Mob, Demob			115,000
	Clearing, Grubbing	200	1,400/AC	280,000
	Dike Construction	190,000	1.20/CY	228,000
	Excavation	5,000,000	1.40/CY	7,000,000
	Subtotal			7,623,000
	Contingencies (25% ±)			1,977,000
	Subtotal			9,600,000
	E&D (8%)			750,000
	S&A (8%)			750,000
	Total 09			11,100,000
	TOTAL			11,100,000

TABLE C-3-15

COST ESTIMATE
Buffalo Cove Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Improve Aligator Bayou			
	Mob, Demob			46,000
	Clearing, Grubbing	70	1,400/AC	98,000
	Excavation (cast)	350,000	1.40/CY	490,000
	Inlet and Outlet Channel			
	Mob, Demob			60,000
	Excavation (cast)	180,000	1.40/CY	252,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,257,400
	Contingencies (25% ±)			302,600
	Subtotal			1,560,000
	E&D (8%)			120,000
	S&A (8%)			120,000
	Total 09			1,800,000
11	LEVEES AND FLOODWALLS			
	Embankment	113,000	2.10/CY	271,200
	Contingencies (25% ±)			64,800
	Subtotal			336,000
	E&D (8%)			27,000
	S&A (8%)			27,000
	Total 11			390,000
	TOTAL			2,190,000

TABLE C-3-16

COST ESTIMATE
Beau Bayou Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Inlet from Little Devil Cut			
	Mob, Demob			46,000
	Clearing, Grubbing	80	1,400/AC	112,000
	Excavation	600,000	1.40/AC	840,000
	Outlet			
	Mob, Demob			60,000
	Excavation (cast)	90,000	1.40/CY	126,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,495,400
	Contingencies (25% ±)			354,600
	Subtotal			1,850,000
	E&D (8%)			150,000
	S&A (8%)			150,000
	Total 09			2,150,000
11	LEVEES AND FLOODWALLS			
	Embankment	3,000	2.40/CY	7,200
	Contingencies (25% ±)			1,700
	Subtotal			8,900
	E&D (8%)			550
	S&A (8%)			550
	Total 11			10,000
	TOTAL			2,160,000

TABLE C-3-17

COST ESTIMATE
Cocodrie Swamp Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit	Estimated Amount
			($)	($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
09	CHANNELS AND CANALS			
	Improvement to Bayou LaRose			
	Mob, Demob			46,000
	Clearing, Grubbing	42	1,400/AC	58,800
	Excavation (cast)	300,000	1.40/CY	420,000
	Outlet			
	Mob, Demob			60,000
	Excavation (cast)	90,000	1.40/CY	126,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			1,022,200
	Contingencies (25% ±)			257,800
	Subtotal			1,280,000
	E&D (8%)			100,000
	S&A (8%)			100,000
	Total 09			1,480,000
	TOTAL			1,480,000

TABLE C-3-18

COST ESTIMATE
Flat Lake Management Unit

Cost Account Number	Description	Estimated Quantity	Cost/Unit ($)	Estimated Amount ($)
01	LANDS AND DAMAGES	Included in Real Estate Plan		
02	RELOCATIONS			
	Mobil Pipeline 8"ϕ			21,000
	Dixie Pipelie 6"ϕ			16,000
	Subtotal			37,000
	Contingencies (25% ±)			8,400
	Subtotal			45,400
	E&D (6%)			2,300
	S&A (6%)			2,300
	Total 02			50,000
09	CHANNELS AND CANALS			
	Channel Excavation			
	Mob, Demob			115,000
	Clearing, Grubbing	130	1,400/AC	182,000
	Dike Construction	120,000	1.20/CY	144,000
	Excavation	2,000,000	1.40/CY	2,800,000
	Inlet and Outlet			
	Mob, Demob			60,000
	Excavation (cast)	180,000	1.40/CY	252,000
	Riprap	18,000	17.30/TN	311,400
	Subtotal			3,864,400
	Contingencies (25% ±)			935,600
	Subtotal			4,800,000
	E&D (8%)			400,000
	S&A (8%)			400,000
	Total 09			5,600,000
11	LEVEES AND FLOODWALLS			
	Embankment	330,000	2.10/CY	792,000
	Contingencies (25% ±)			198,000
	Subtotal			990,000
	E&D (8%)			80,000
	S&A (8%)			80,000
	Total 11			1,150,000
	TOTAL			6,800,000

TABLE C-3-19

COST ESTIMATE
Freshwater Diversion Structure

Cost Account Number	Description	Estimated Quantity	Estimated Amount ($)
01	LANDS AND DAMAGES		
	Perpetual Channel, Borrow and Levee		
	Homesites	7 AC	24,500
	High Woodland	442 AC	618,800
	Improvements		121,800
	Subtotal		765,100
	Contingencies (25% ±)		190,900
	PL 91-646		105,000
	Acquisition Cost		28,000
	Total 01		1,089,000
06	FISH AND WILDLIFE FACILITIES		
	Henderson		2,415,000
	Sherburne		2,415,000
	Subtotal		4,830,000
	Contingencies (25% ±)		1,190,000
	Subtotal		6,020,000
	E&D (8%)		500,000
	S&A (8%)		500,000
	Total 15		7,020,000
	TOTAL		8,109,000

C.3.38. Construction of a new inlet for Buffalo Cove from Aligator Bayou would be required. The inlet is presently designed as a 400-foot-wide broad-crested weir. Rip-rap would be required upstream and downstream of the weir. The outlet to Lake Fausse Point cut is a rip-rap weir 40 feet wide. Cost estimates for the inlet and outlet are presented in Table C-3-15.

C.3.39. The remaining units would require construction of inlets and outlets. These estimates are included in Tables C-3-16 through C-3-18.

LEVEES, FLOODWALLS, LOCKS, AND PUMPING PLANTS

C.3.40. Costs estimates for levees, floodwalls, locks, and pumping plants are dependent on the flowline; therefore, they vary with each alternative plan. Cost estimates for future without-project, NED, EQ, and the recommended plans are contained in Tables C-3-20 through C-3-23. Estimates for levee construction were based on past experience in building these levees. The estimate considers the requirement for changing from an all-earthen levee to a floodwall because of the height of the flowline.

C.3.41. The estimates shown in Tables C-3-20 through C-3-23 use an estimated start date of October 1985 for the proposed new flowline and are adjusted to an October 1981 price level. Construction of levees and floodwalls scheduled for award through FY 1984 are not included in these tables but are shown in Table C-3-24 (used October 1979 PB-3 and schedule from 20 November 1979 PB-2A).

C.3.42. Table C-3-25 summarizes the features contained in the NED, EQ, TS, and recommended plans.

TABLE C-3-20

COST ESTIMATE
Future Without
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Easements	7,166,000
	Improvements	348,000
	Subtotal	7,514,000
	Contingencies (25%±)	1,880,000
	Acquisition Cost	1,104,000
	Resettlement	102,000
	Total 01	10,600,000
02	RELOCATIONS	18,030,000
	Contingencies (25% ±)	4,570,000
	Subtotal	22,600,000
	E&D (6%)	1,350,000
	S&A (6%)	1,350,000
	Total 02	25,300,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,788,000
	Subtotal	19,545,000
	Contingencies (25% ±)	4,855,000
	Subtotal	24,400,000
	E&D (8%)	1,950,000
	S&A (8%)	1,950,000
	Total 05	28,300,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	380,670,000
	Service Roads (429 miles)	5,440,000
	East and West Calumet Floodgate	15,640,000
	Charenton Floodgate	10,780,000
	Wax Lake East Draining Structure	1,260,000
	Wax Lake West Draining Structure	1,010,000
	Subtotal	414,800,000
	Contingencies (25%±)	103,850,000
	Subtotal	518,650,000
	E&D (8%)	41,500,000
	S&A (8%)	41,500,000
	Total 11	601,650,000

TABLE C-3-20 (Continued)

COST ESTIMATE
Future Without
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	500,000
	Wax Lake West	347,000
	Ellerslie	58,000
	North Bend	132,000
	Maryland	132,000
	Centerville	132,000
	Bayou Yokely and Enlargement	600,000
	Franklin	113,000
	Gordy	162,000
	Subtotal	2,176,000
	Contingencies (25% ±)	544,000
	Subtotal	2,720,000
	E&D (8%)	215,000
	S&A (8%)	215,000
	Total 13	3,150,000
	TOTAL	669,000,000

TABLE C-3-21

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	7,005,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Outlet Control (100/0)	16,000
	Widen Wax Lake Outlet	6,341,000
	Avoca Island Levee Extension (Adjacent to Channel)	132,000
	Channel Training Below Morgan City	617,000
	Subtotal	14,764,000
	Contingencies (25%±)	3,687,000
	Acquisition Cost	1,528,000
	Resettlement	444,000
	Total 01	20,423,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	15,617,000
	Outlet Control (100/0)	365,000
	Widen Wax Lake Outlet	30,409,000
	Avoca Island Levee Extension	3,225,000
	Subtotal	49,616,000
	Contingencies (25% ±)	12,419,000
	Subtotal	62,035,000
	E&D (6%)	3,740,000
	S&A (6%)	3,740,000
	Total 02	69,515,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25% ±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-21 (Continued)

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Avoca Island Levee Extension	5,137,000
	Contingencies (25% ±)	1,283,000
	Subtotal	6,420,000
	E&D (8%)	510,000
	S&A (8%)	510,000
	Total 06	7,440,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	9,715,000
	Channel Training Below Morgan City	7,454,000
	Subtotal	52,919,000
	Contingencies (25% ±)	13,425,000
	Subtotal	66,344,000
	E&D (8%)	5,164,000
	S&A (8%)	5,164,000
	Total 09	76,672,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	255,128,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,506,000
	Wax Lake West Drainage Structure	1,276,000
	Outlet Control (100/0)	13,380,000
	Widen Wax Lake Outlet	27,124,800
	Avoca Island Levee Extension	178,876,000
	Subtotal	500,980,800
	Contingencies (25% ±)	124,959,200
	Subtotal	625,940,000
	E&D (8%)	50,100,000
	S&A (8%)	50,100,000
	Total 11	726,140,000

TABLE C-3-21 (Continued)

COST ESTIMATE
NED Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25% ±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	1,054,000,000

TABLE C-3-22

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	6,875,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Sherburne and Henderson Freshwater Structures	765,000
	Outlet Control (70/30)	14,000
	Increase Sediment Through WLO	16,000
	Widen Wax Lake Outlet	6,341,000
	Subtotal	14,664,000
	Contingencies (25% ±)	3,667,000
	Acquisition Cost	1,480,000
	Resettlement	533,000
	Total 01	20,344,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	11,615,000
	Management Units	37,000
	Outlet Control (70/30)	365,000
	Widen Wax Lake Outlet	30,409,000
	Subtotal	42,426,000
	Contingencies (25% ±)	10,606,000
	Subtotal	53,032,000
	E&D (6%)	3,181,000
	S&A (6%)	3,181,000
	Total 02	59,394,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25% ±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-22 (Continued)

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Sherburne and Courtableau Freshwater Structures	4,830,000
	Contingencies (25% ±)	1,210,000
	Subtotal	6,040,000
	E&D (8%)	480,000
	S&A (8%)	480,000
	Total 06	7,000,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	17,171,500
	Management Units	15,262,400
	Increase Sediment Through WLO	14,675,000
	Subtotal	82,858,900
	Contingencies (25%±)	21,057,100
	Subtotal	103,916,000
	E&D (8%)	8,180,000
	S&A (8%)	8,180,000
	Total 09	120,276,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	259,262,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,506,000
	Wax Lake West Drainage Structure	1,276,000
	Managment Units	1,070,400
	Outlet Control (70/30)	7,099,600
	Widen Wax Lake Outlet	27,124,800
	Subtotal	321,028,800
	Contingencies (25% ±)	80,669,200
	Subtotal	401,698,000
	E&D (8%)	32,239,000
	S&A (8%)	32,239,000
	Total 11	466,176,000

TABLE C-3-22 (Continued)

COST ESTIMATE
EQ Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25%±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	827,000,000

TABLE C-3-23

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
01	LANDS AND DAMAGES	
	Enlargement of Existing Levees and Floodwalls	6,901,000
	Channel Training Above Morgan City	327,000
	Channel Realinement	326,000
	Sherburne and Henderson Freshwater Structures	765,100
	Outlet Control (70/30)	14,000
	Widen Wax Lake Outlet	6,341,000
	Channel Training Below Morgan City	617,000
	Subtotal	15,291,100
	Contingencies (25%±)	3,823,900
	Acquisition Cost	1,528,000
	Resettlement	687,000
	Total 01	21,330,000
02	RELOCATIONS	
	Enlargement of Existing Levees and Floodwalls	14,970,000
	Management Units	37,000
	Outlet Control (70/30)	365,000
	Widen Wax Lake Outlet	30,409,000
	Subtotal	45,781,000
	Contingencies (25%±)	11,233,000
	Subtotal	57,014,000
	E&D (6%)	3,512,000
	S&A (6%)	3,512,000
	Total 02	64,038,000
05	LOCKS	
	Bayou Boeuf Lock	735,000
	Berwick Lock	8,022,000
	Bayou Sorrel Lock	10,420,000
	Subtotal	19,177,000
	Contingencies (25%±)	4,783,000
	Subtotal	23,960,000
	E&D (8%)	1,920,000
	S&A (8%)	1,920,000
	Total 05	27,800,000

TABLE C-3-23 (Continued)

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
06	FISH AND WILDLIFE FACILITIES	
	Sherburne and Henderson Freshwater Structures	4,830,000
	Contingencies (25%±)	1,190,000
	Subtotal	6,020,000
	E&D (8%)	500,000
	S&A (8%)	500,000
	Total 06	7,020,000
09	CHANNELS AND CANALS	
	Channel Training Above Morgan City	35,750,000
	Channel Realinement	9,715,000
	Management Units	15,262,400
	Channel Training Below Morgan City	7,454,000
	Subtotal	68,181,400
	Contingencies (25%±)	17,252,600
	Subtotal	85,434,000
	E&D (8%)	6,684,000
	S&A (8%)	6,684,000
	Total 09	98,802,000
11	LEVEES AND FLOODWALLS	
	Existing Levee Enlargement	238,000,000
	Service Roads (429 miles)	5,440,000
	East Calumet Floodgate	7,820,000
	Charenton Floodgate	10,430,000
	Wax Lake East Drainage Structure	1,566,000
	Wax Lake West Drainage Structure	1,276,000
	Management Units	1,070,400
	Outlet Control (70/30)	7,099,600
	Widen Wax Lake Outlet	27,124,800
	Subtotal	299,766,800
	Contingencies (25%±)	75,233,200
	Subtotal	375,000,000
	E&D (8%)	30,000,000
	S&A (8%)	30,000,000
	Total 11	435,000,000

TABLE C-3-23 (Continued)

COST ESTIMATE
Recommended Plan
(APPENDIX C FEATURES ONLY--POST FY 1985)

Cost Account Number	Description	Estimated Amount ($)
13	PUMPING PLANTS	
	Wax Lake East	678,000
	Wax Lake West	472,000
	Ellerslie	77,000
	North Bend	179,000
	Maryland	179,000
	Centerville	179,000
	Bayou Yokely and Enlargement	805,000
	Franklin	155,000
	Gordy	218,000
	Subtotal	2,942,000
	Contingencies (25% ±)	738,000
	Subtotal	3,680,000
	E&D (8%)	290,000
	S&A (8%)	290,000
	Total 13	4,260,000
16	BANK STABILIZATION	
	Main Channel	72,335,000
	Channel Realinement	11,500,000
	Subtotal	83,835,000
	Contingencies (25% ±)	21,115,000
	Subtotal	104,950,000
	E&D (8%)	8,400,000
	S&A (8%)	8,400,000
	Total 16	121,750,000
	TOTAL	780,000,000

TABLE C-3-24

COST ESTIMATE
CONSTRUCTION STARTS SCHEDULED FOR FY 1982-1985*

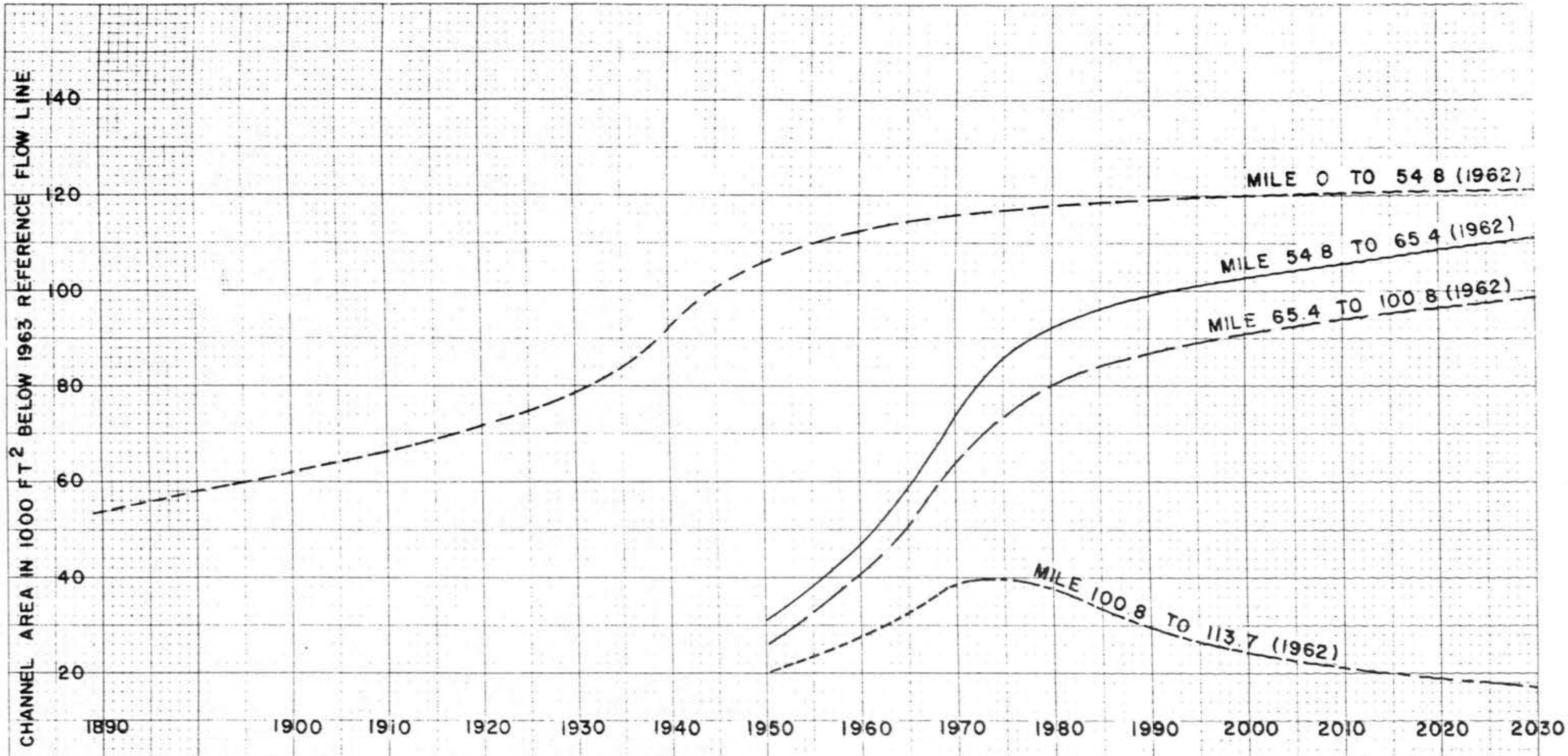
01	LANDS AND DAMAGES	993,000
02	RELOCATIONS	8,898,000
11	LEVEES AND FLOODWALLS	167,185,000
30	E&D	13,890,000
31	S&A	13,890,000
	TOTAL	204,856,000

*Based on schedule in 20 November 1979 PB-2A and October 1981 PB-3

TABLE C-3-25

PLAN FEATURE SUMMARY

	EQ	NED	TS	RCMD
Raised Levees Where Required	X	X	X	X
Main Channel				
Dredge 100,000 square feet				
Channel Training	X	X	X	X
Overbanks				
Channel Realinement	X	X	X	X
Management Units	X		X	X
Outlets (LAR/WLO)				
70/30	X		X	X
100/0		X		
Increase Sediment thru WLO	X			
Widen WLO overbank	X	X	X	X
Lower Atchafalaya River				
Avoca Island Levee Extension		X	X	
Channel Training below Morgan City		X	X	X



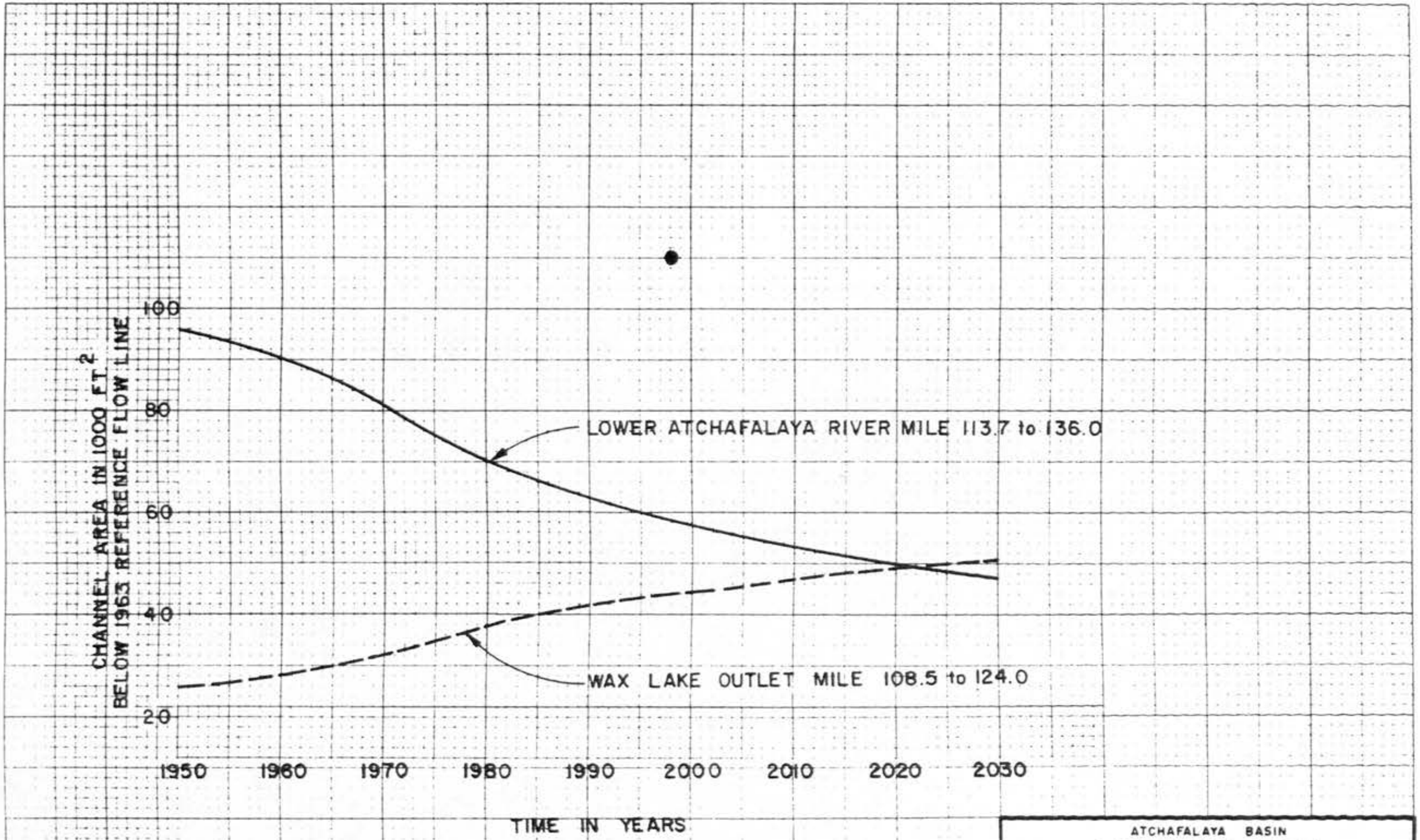
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
FUTURE WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-1



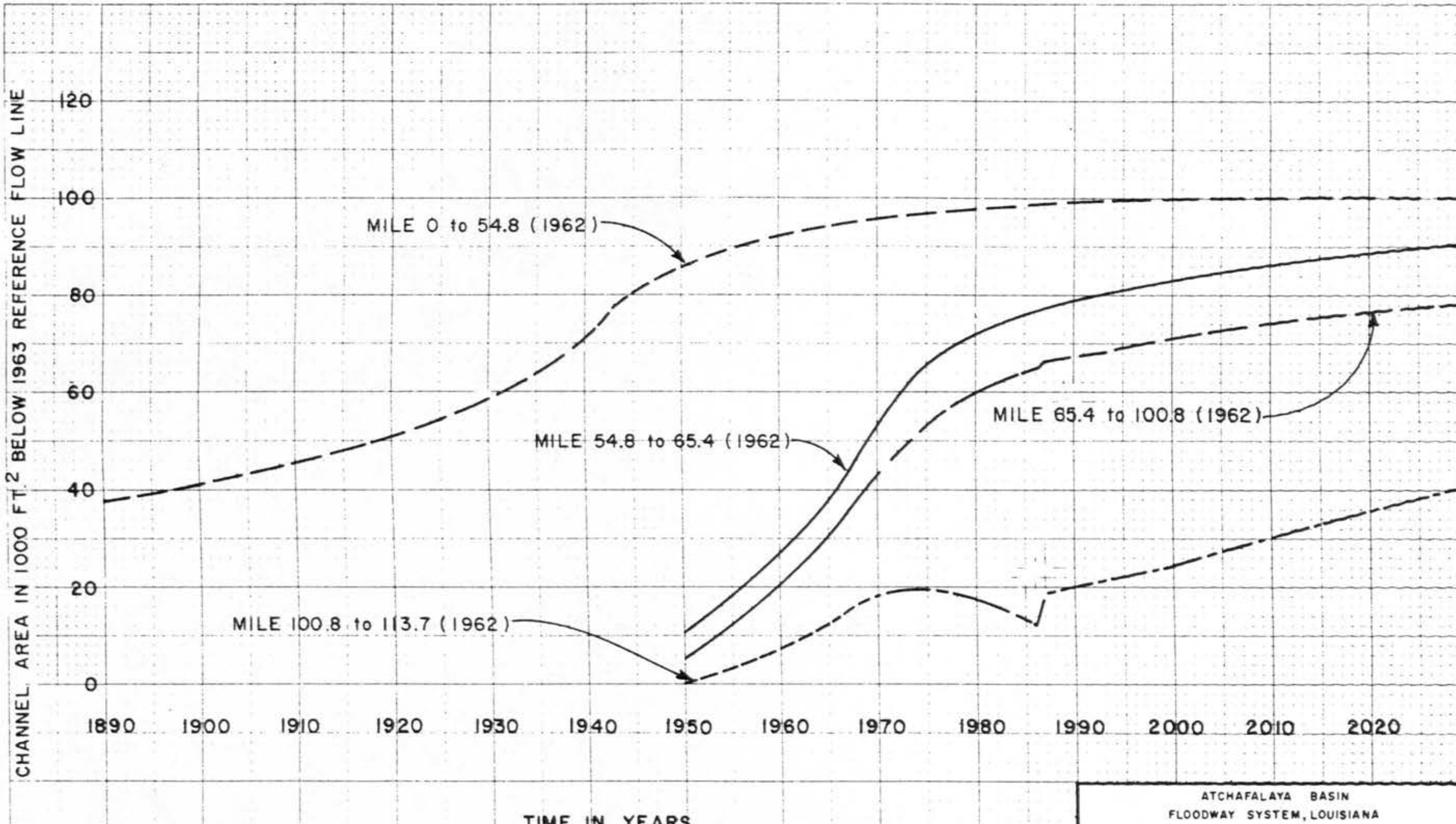
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

RATE OF DEVELOPMENT
FUTURE WITHOUT PROJECT

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-2



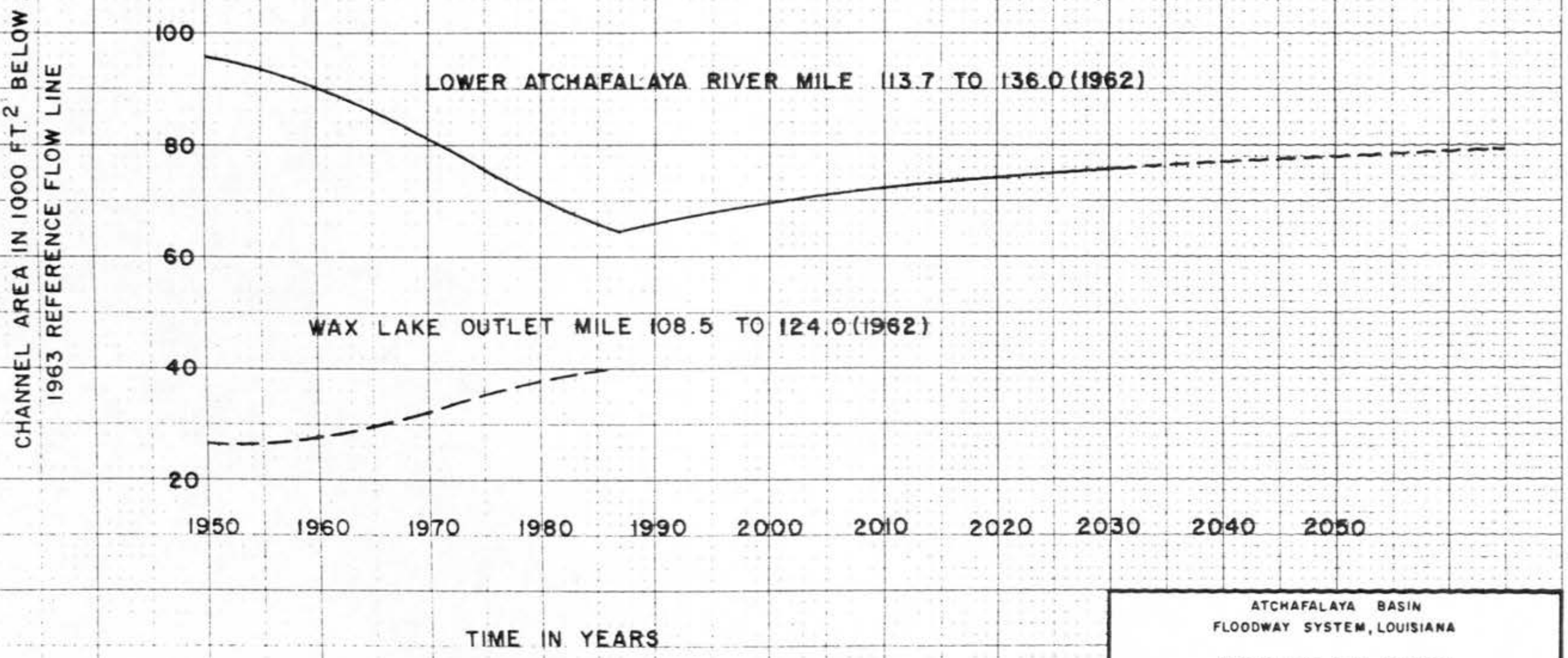
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
EQ PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-3



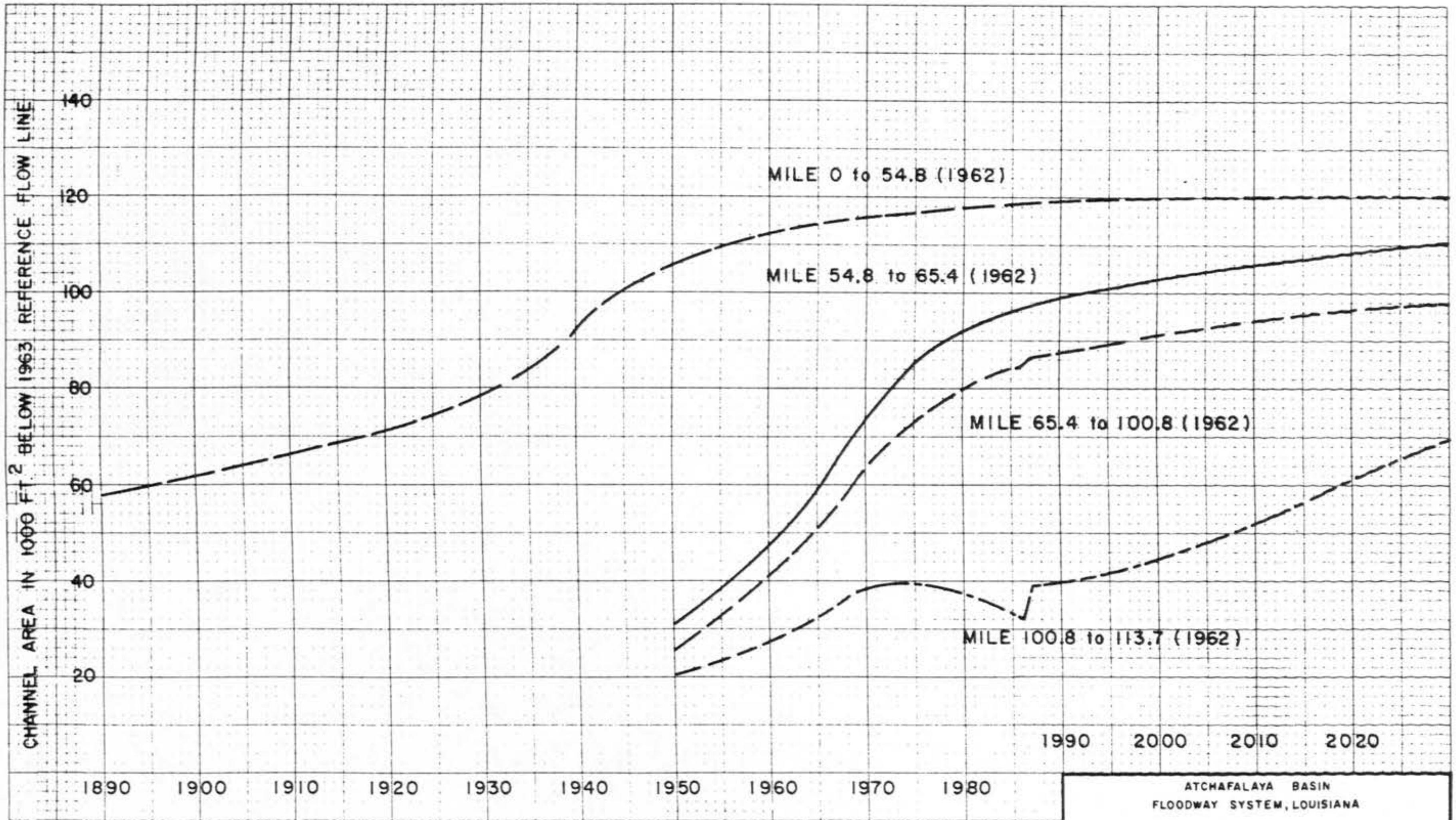
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
EQ PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-4



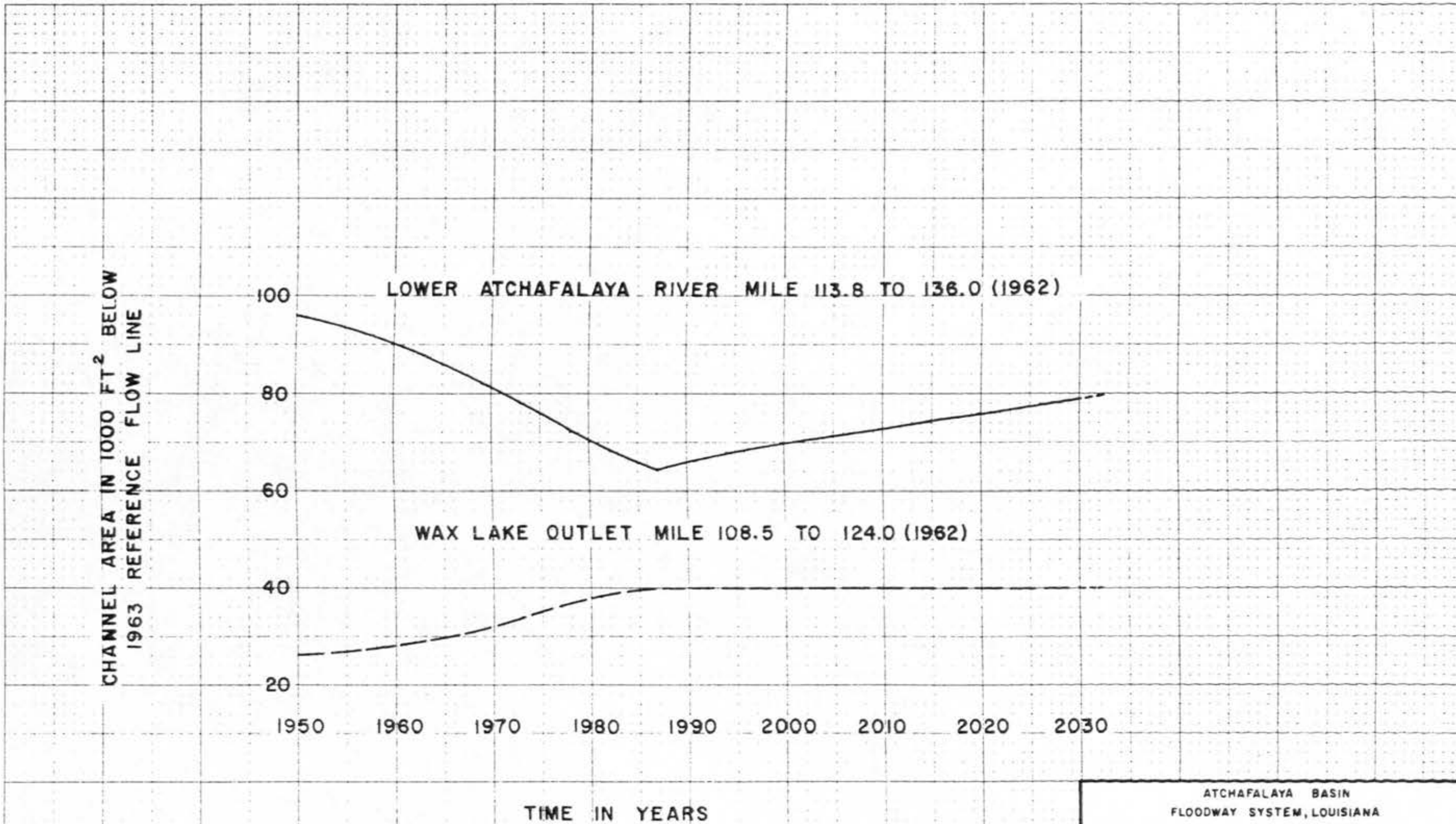
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
NED PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-5

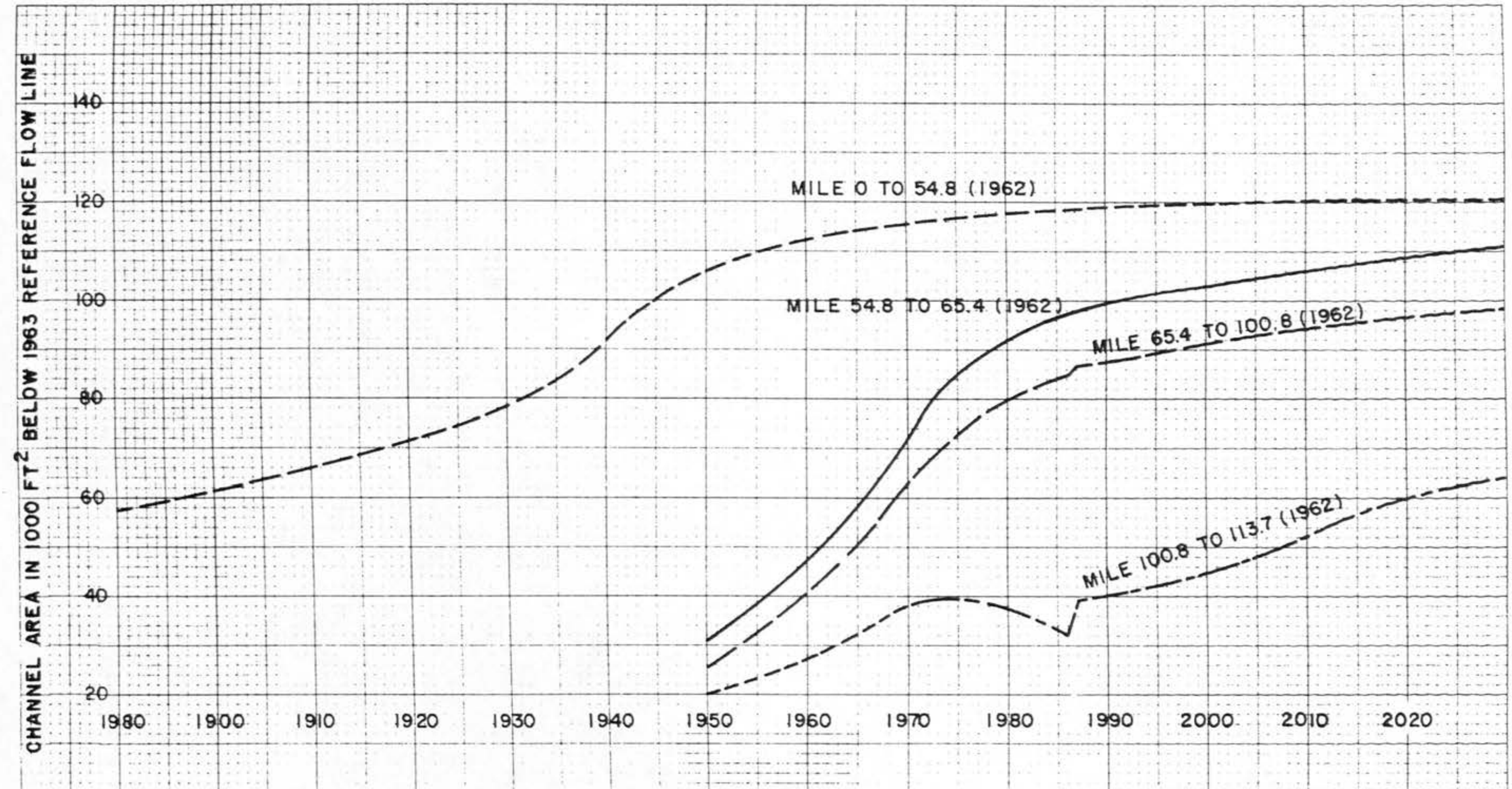


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
NED PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

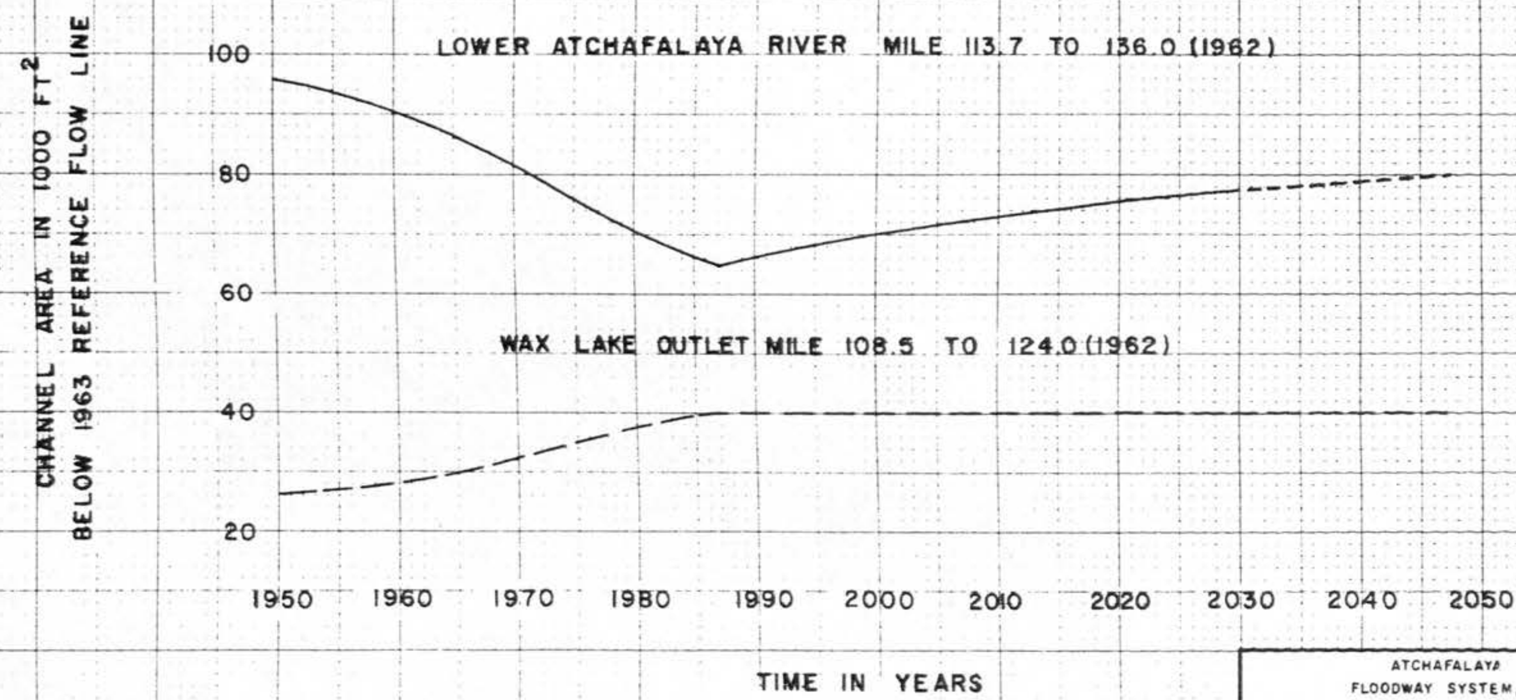
ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
RECOMMENDED PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-7

PLATE C-7



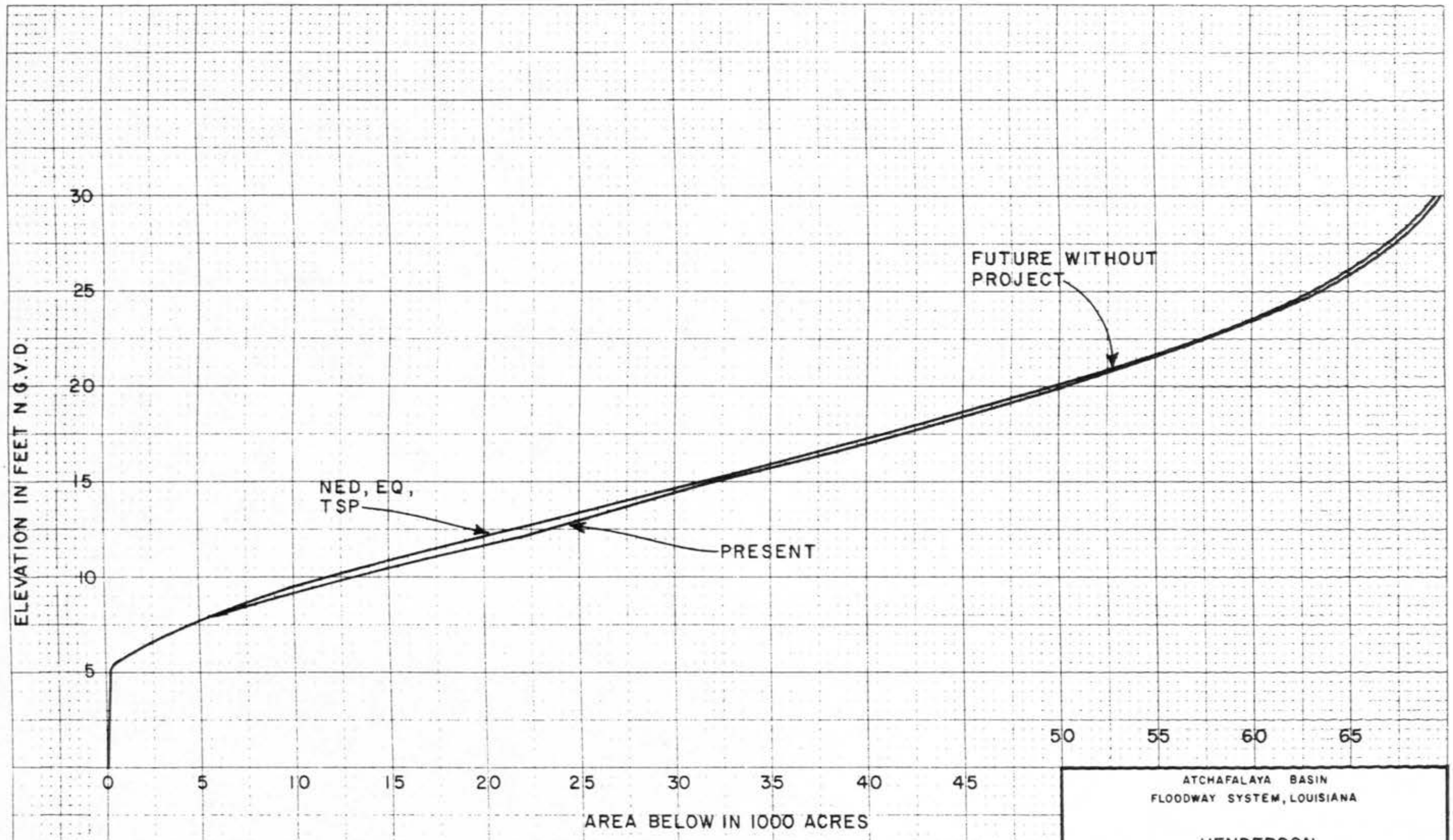
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BASIN
RATE OF DEVELOPMENT
RECOMMENDED PLAN

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-8



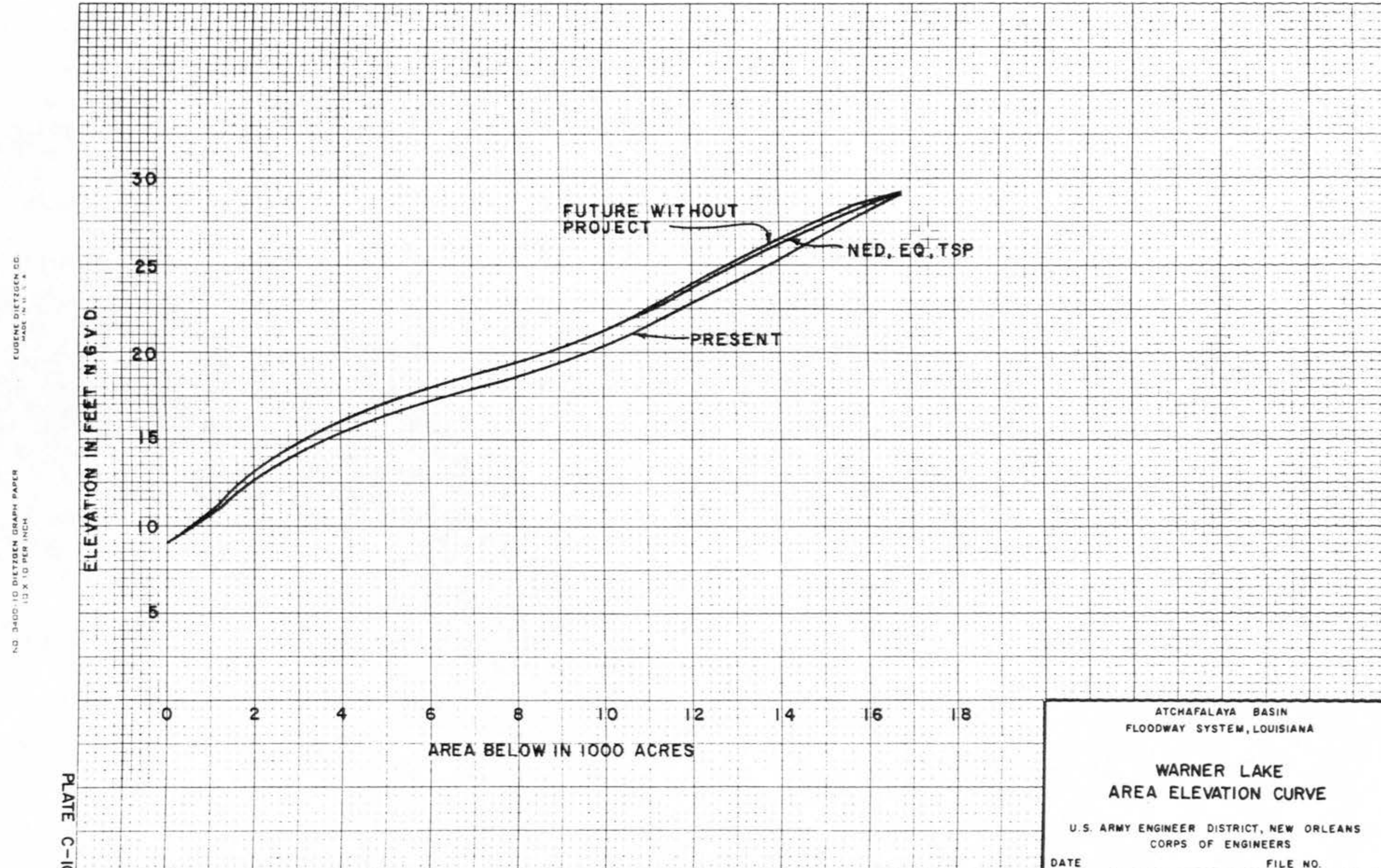
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

HENDERSON
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-9



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

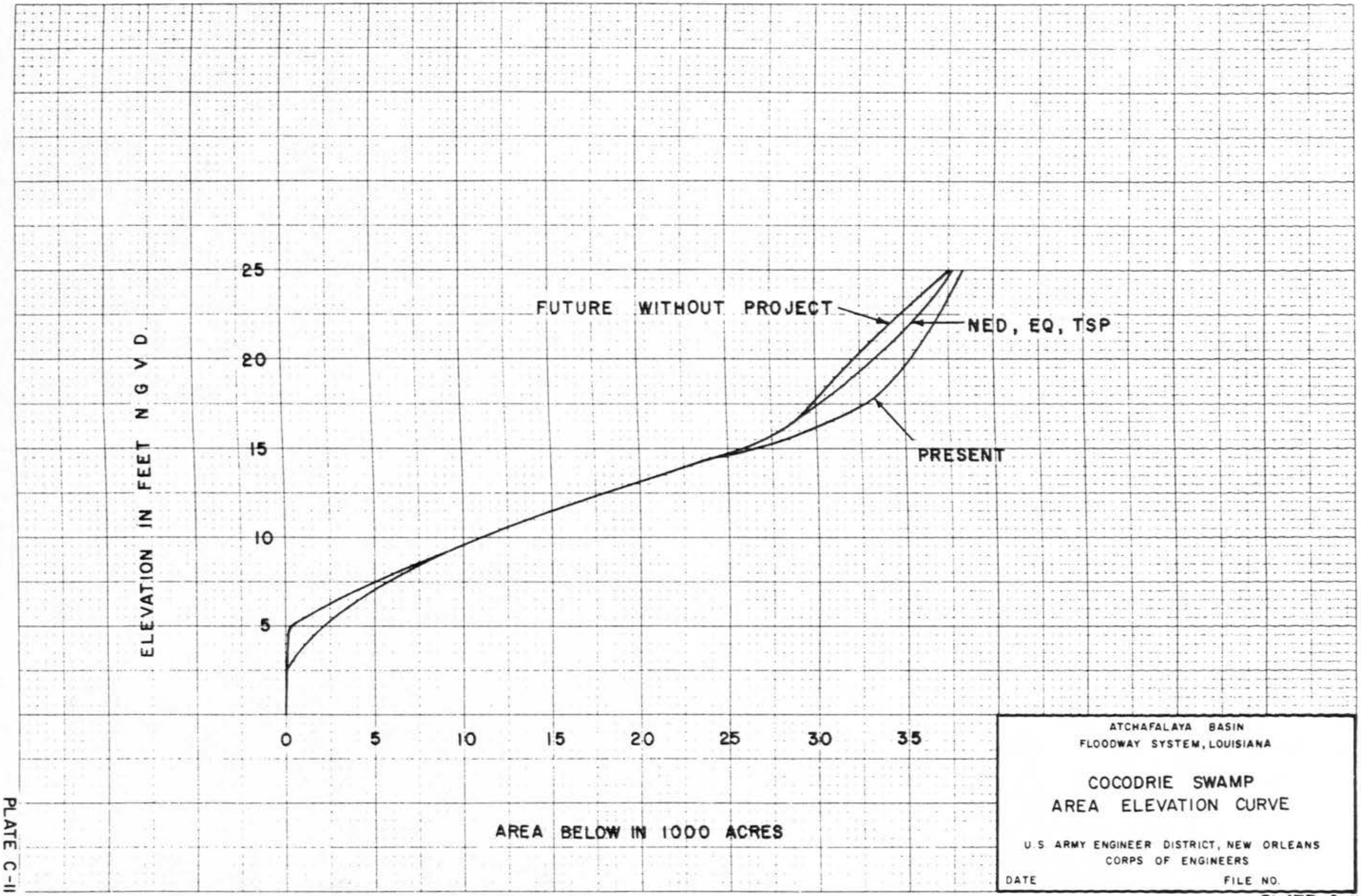
WARNER LAKE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE C-10



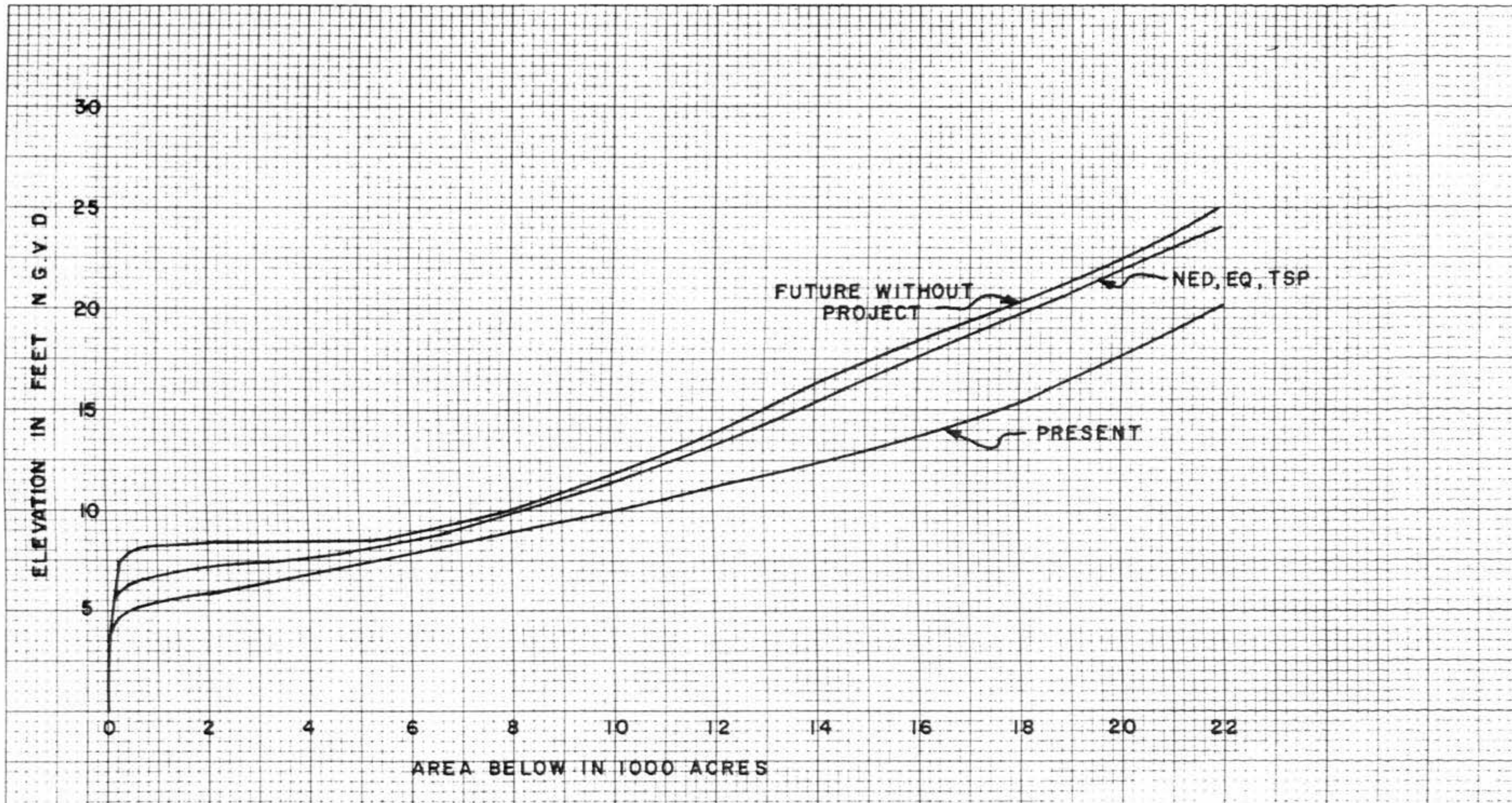
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

COCODRIE SWAMP
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-11



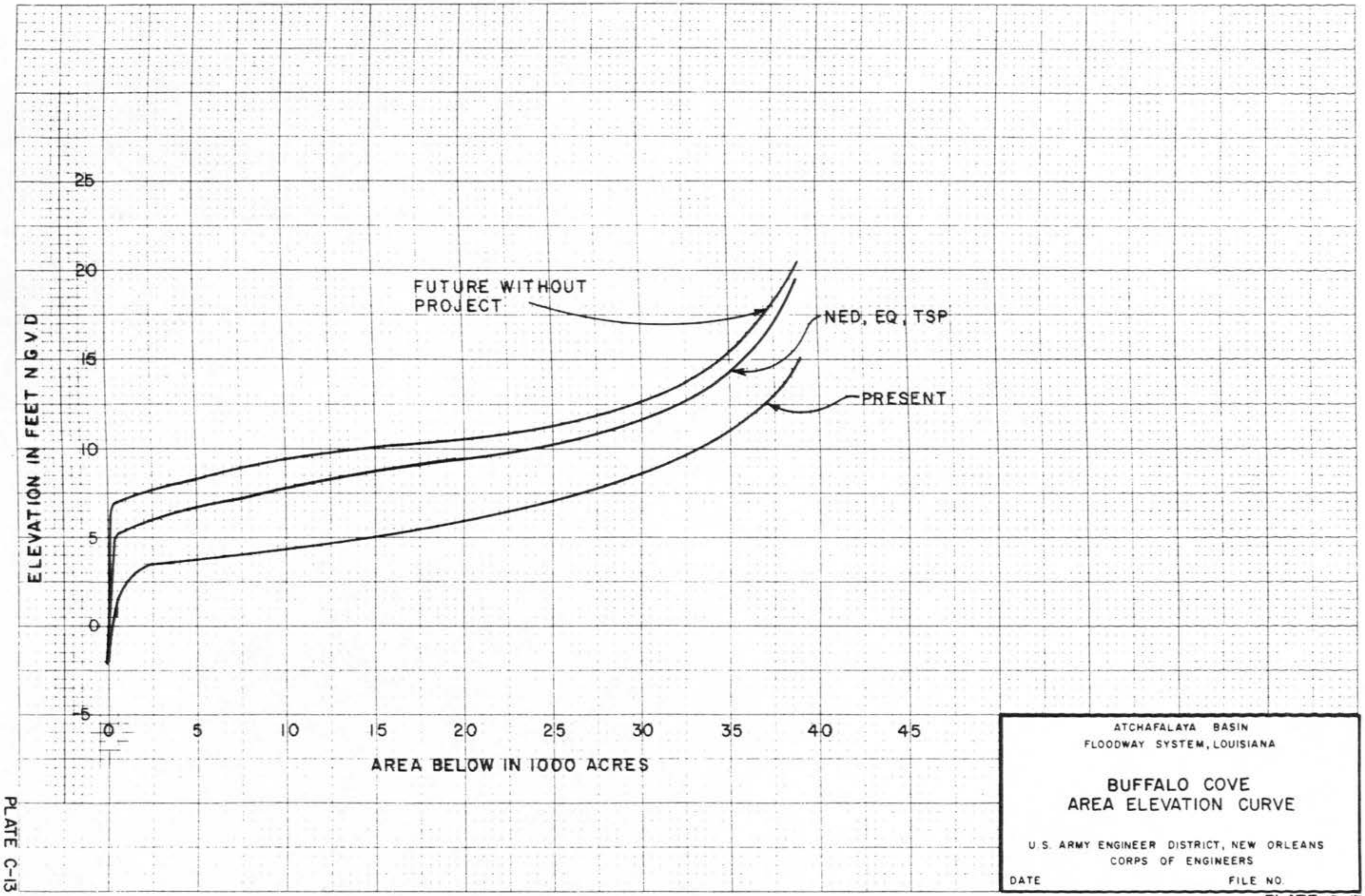
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BEAU BAYOU
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-12



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

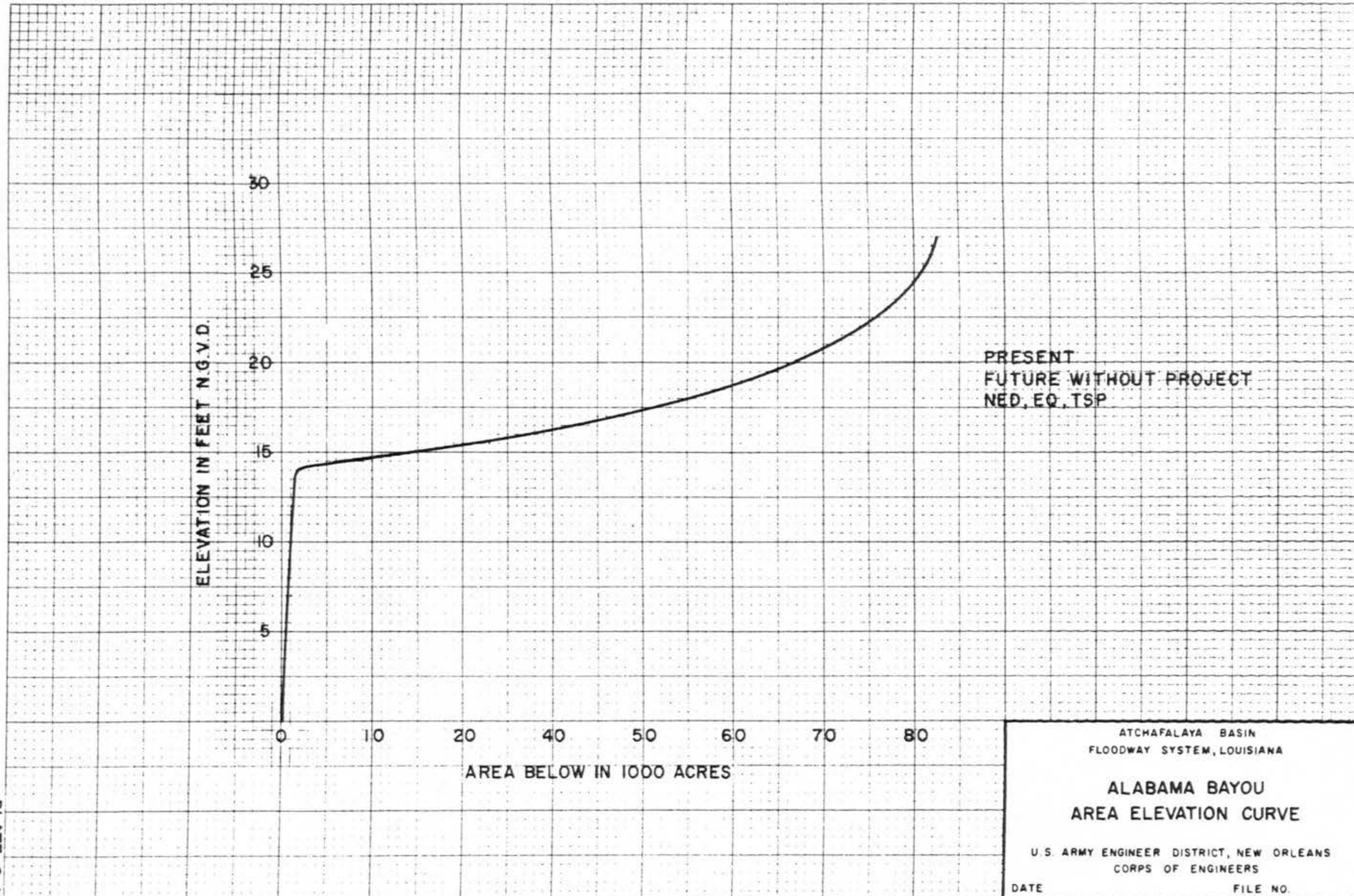
BUFFALO COVE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-13

PLATE C-13



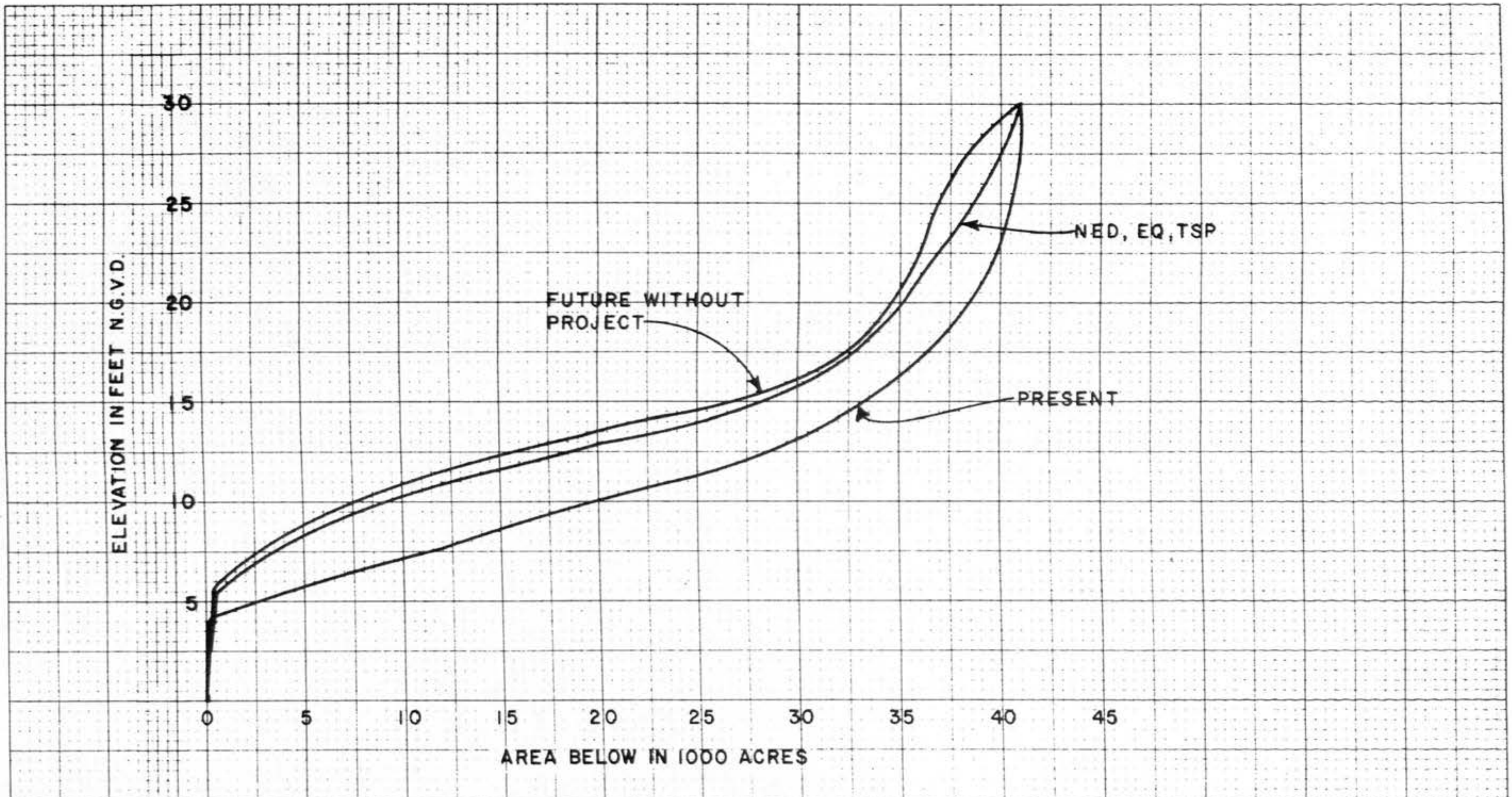
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ALABAMA BAYOU
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-14



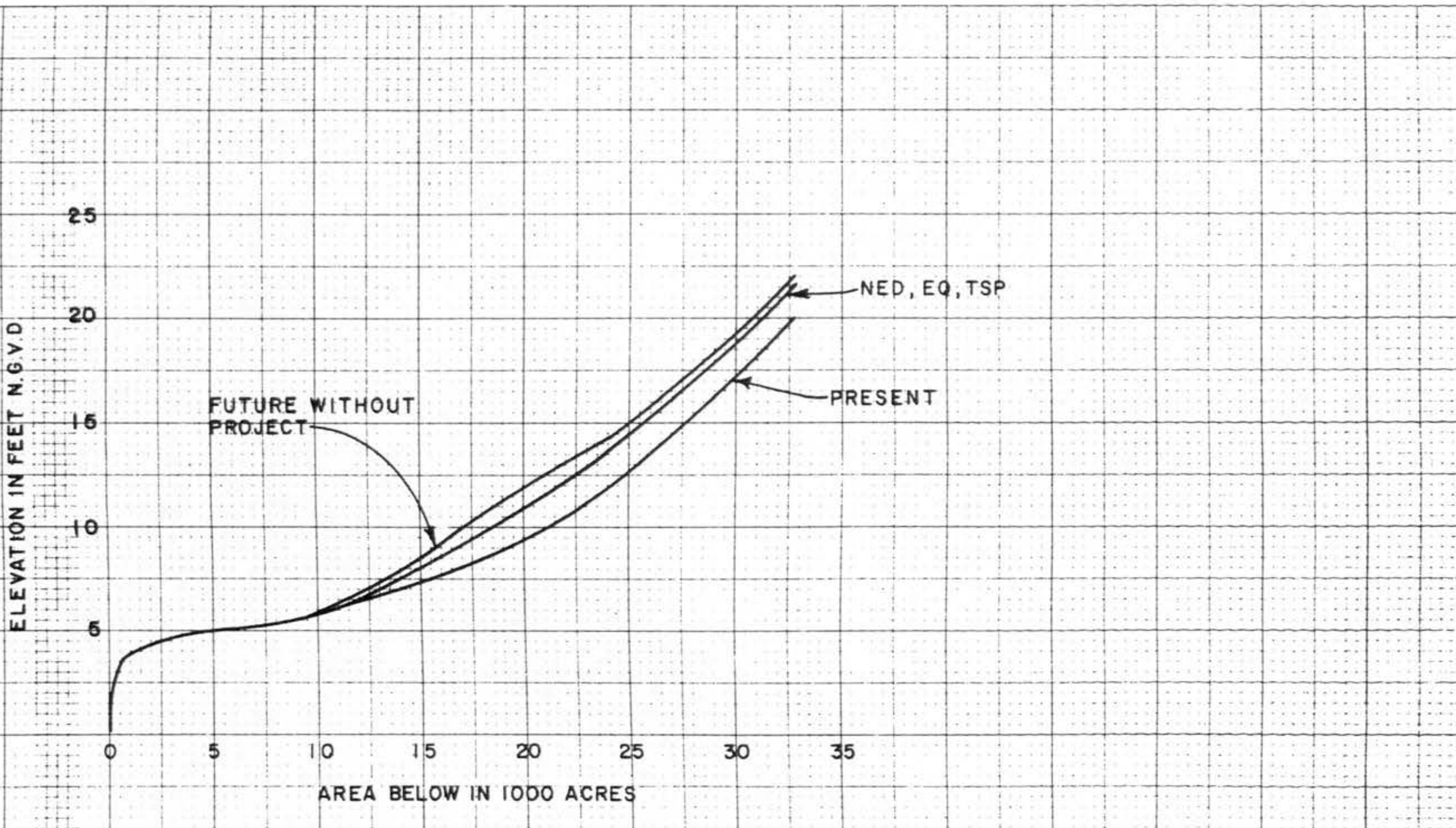
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BAYOU DES GLAISES
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-15



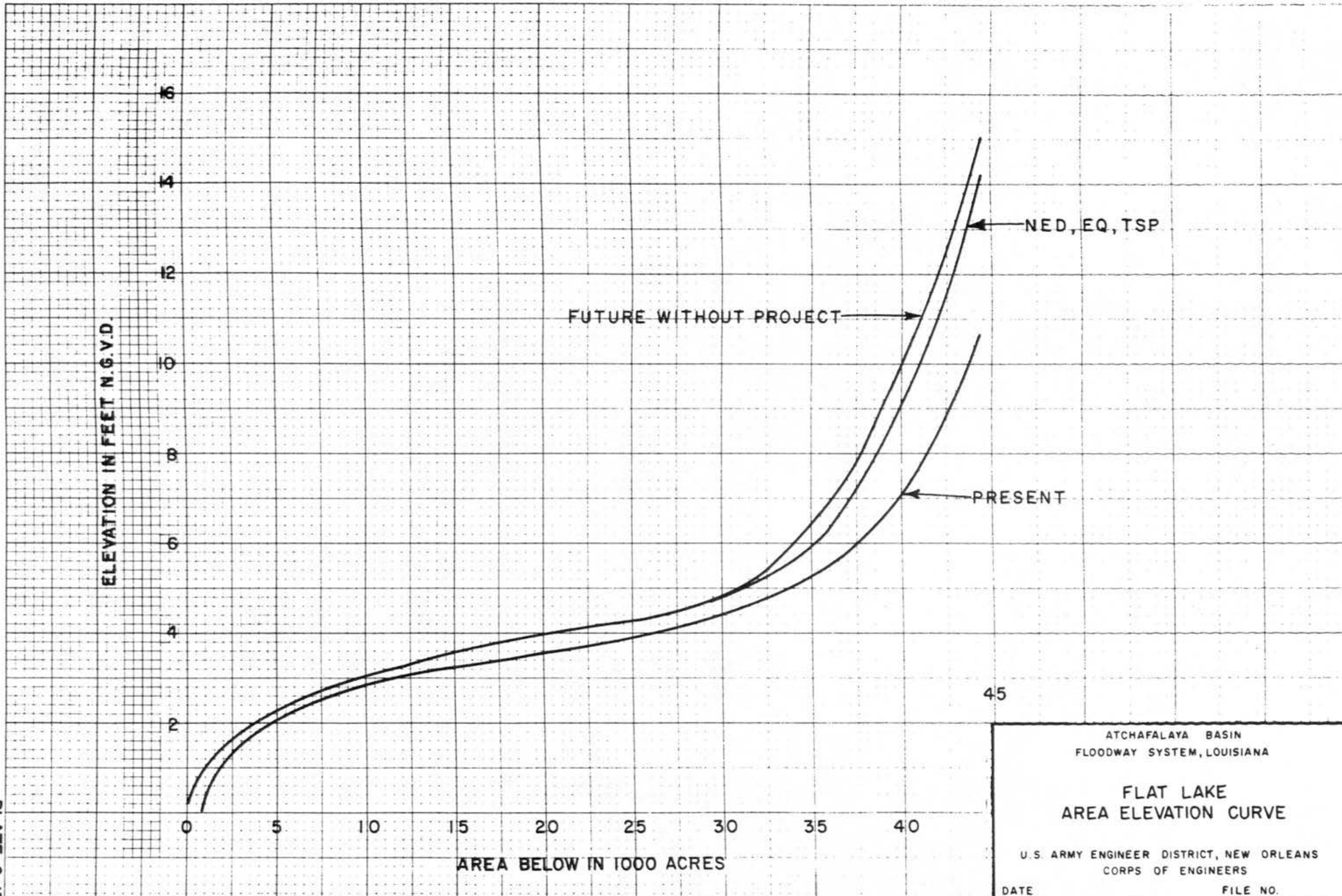
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

PIGEON BAY
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-16



45

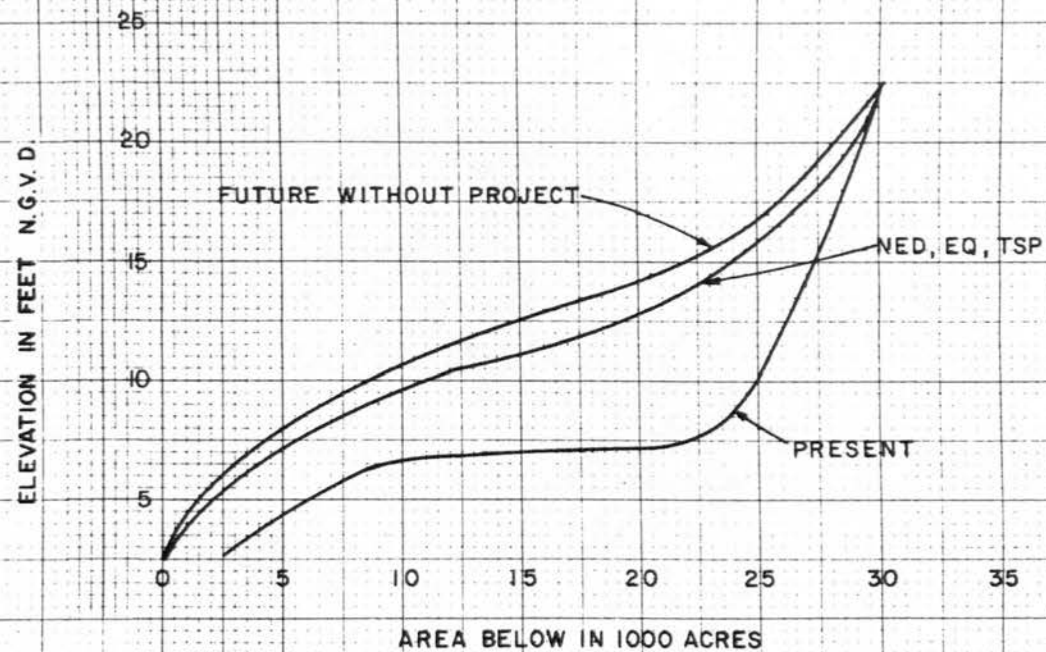
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

FLAT LAKE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-17



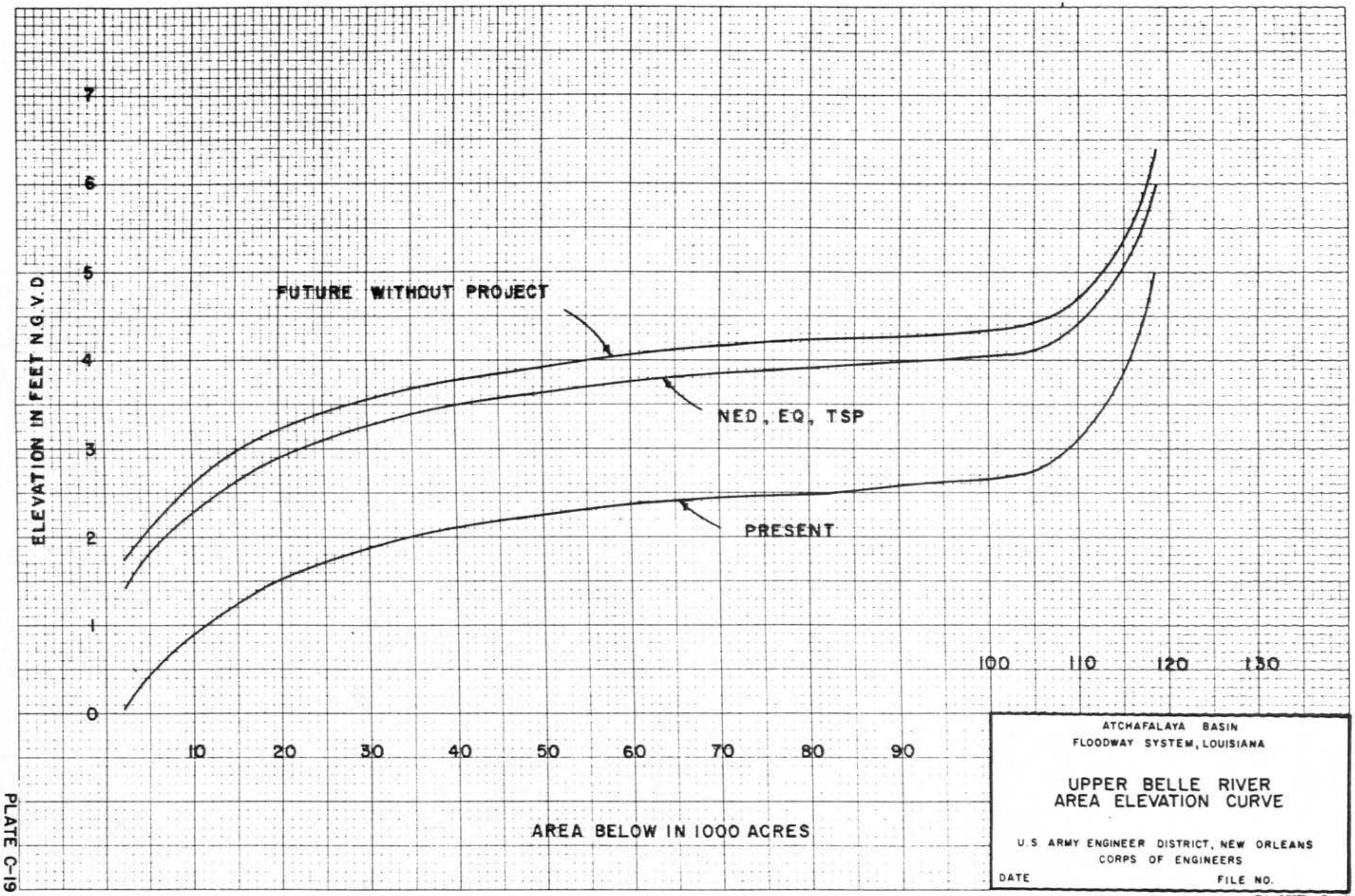
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

CREVASSE
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-18

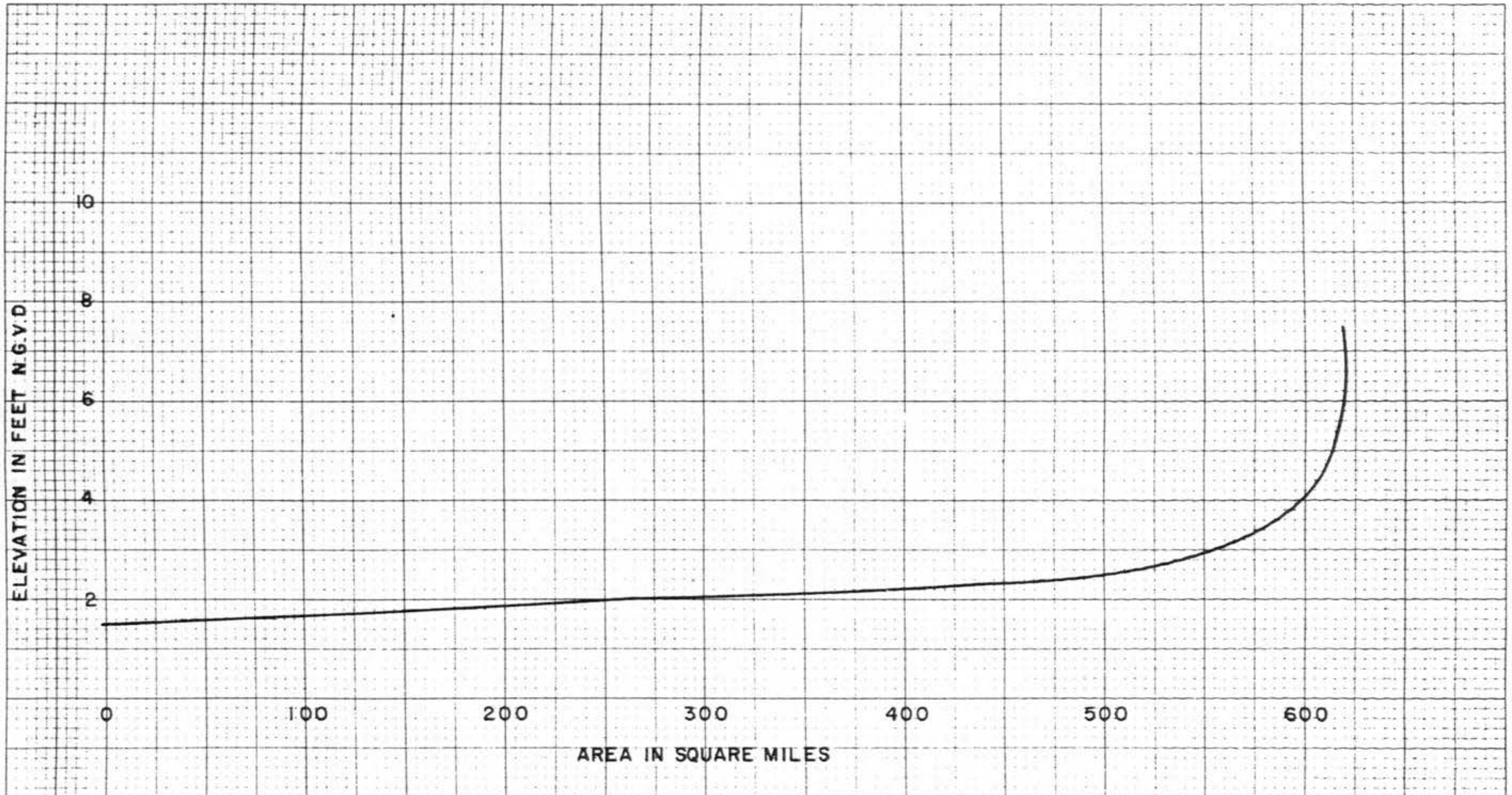


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

UPPER BELLE RIVER
AREA ELEVATION CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



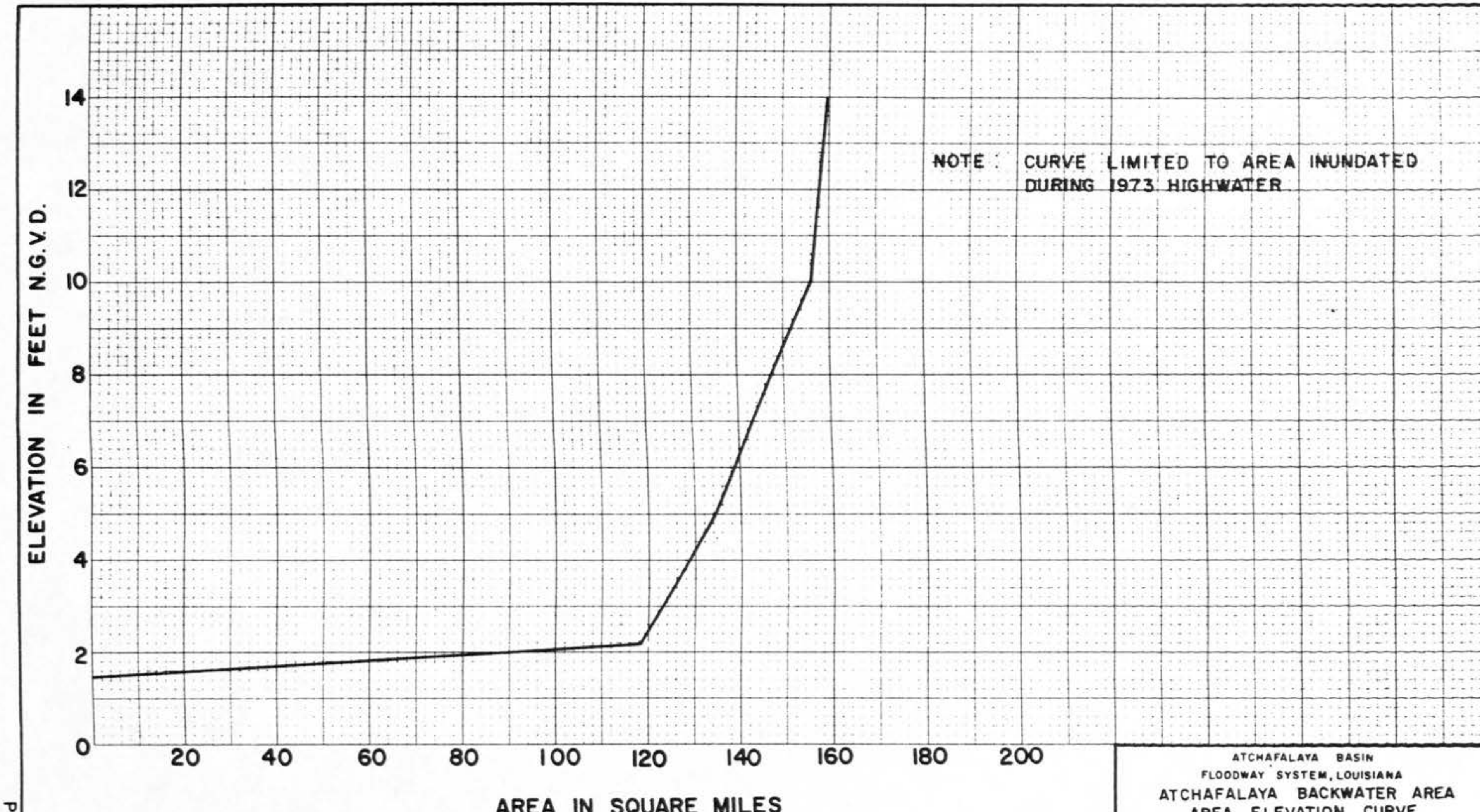
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCH. BACKWATER AREA
AREA ELEVATION CURVE
ZONE O-SOUTH OF GIWW

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

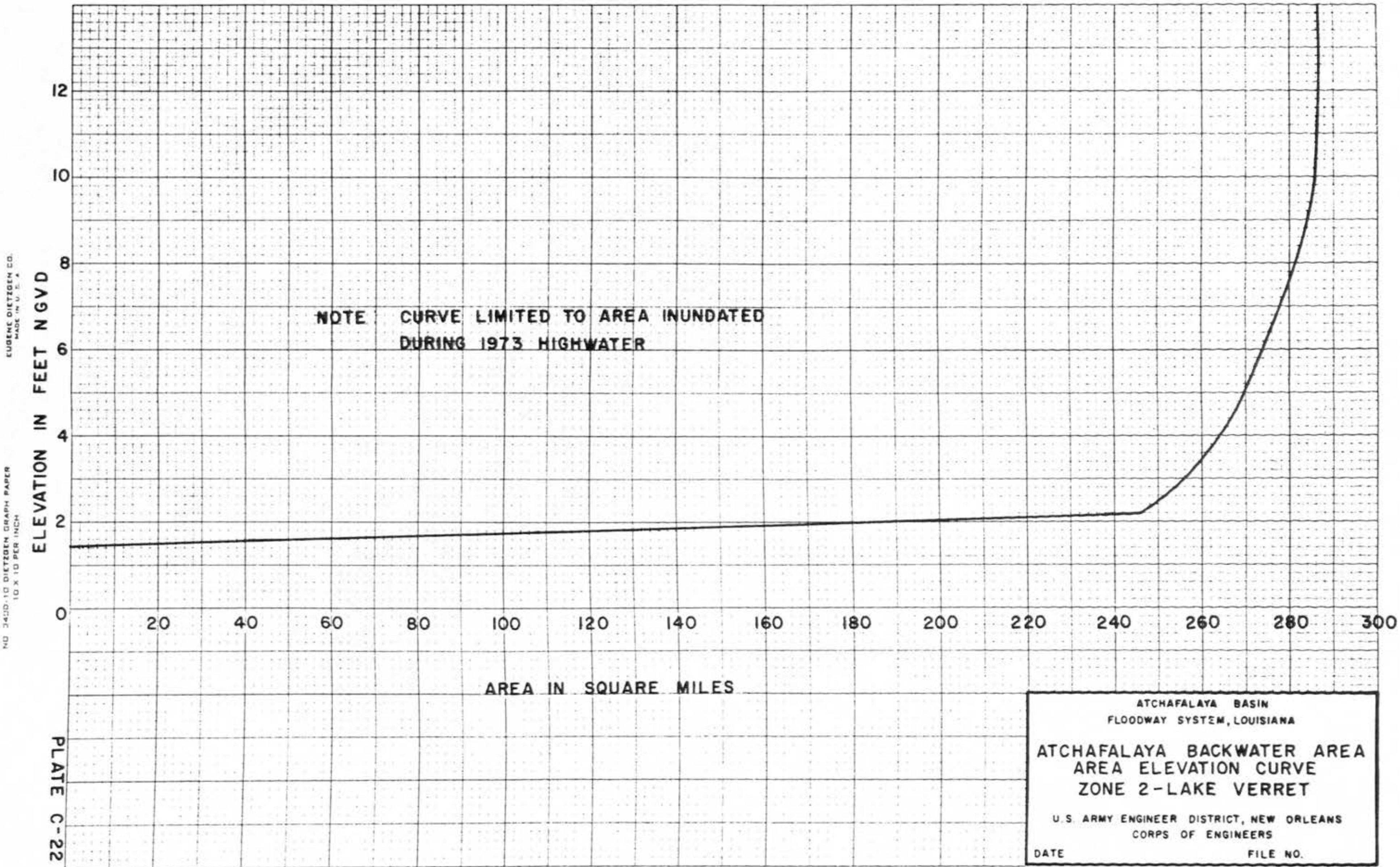
DATE FILE NO.

PLATE C-20



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE I-NORTH OF GIWW
SOUTH OF RAILROAD
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE FILE NO.

PLATE C-21

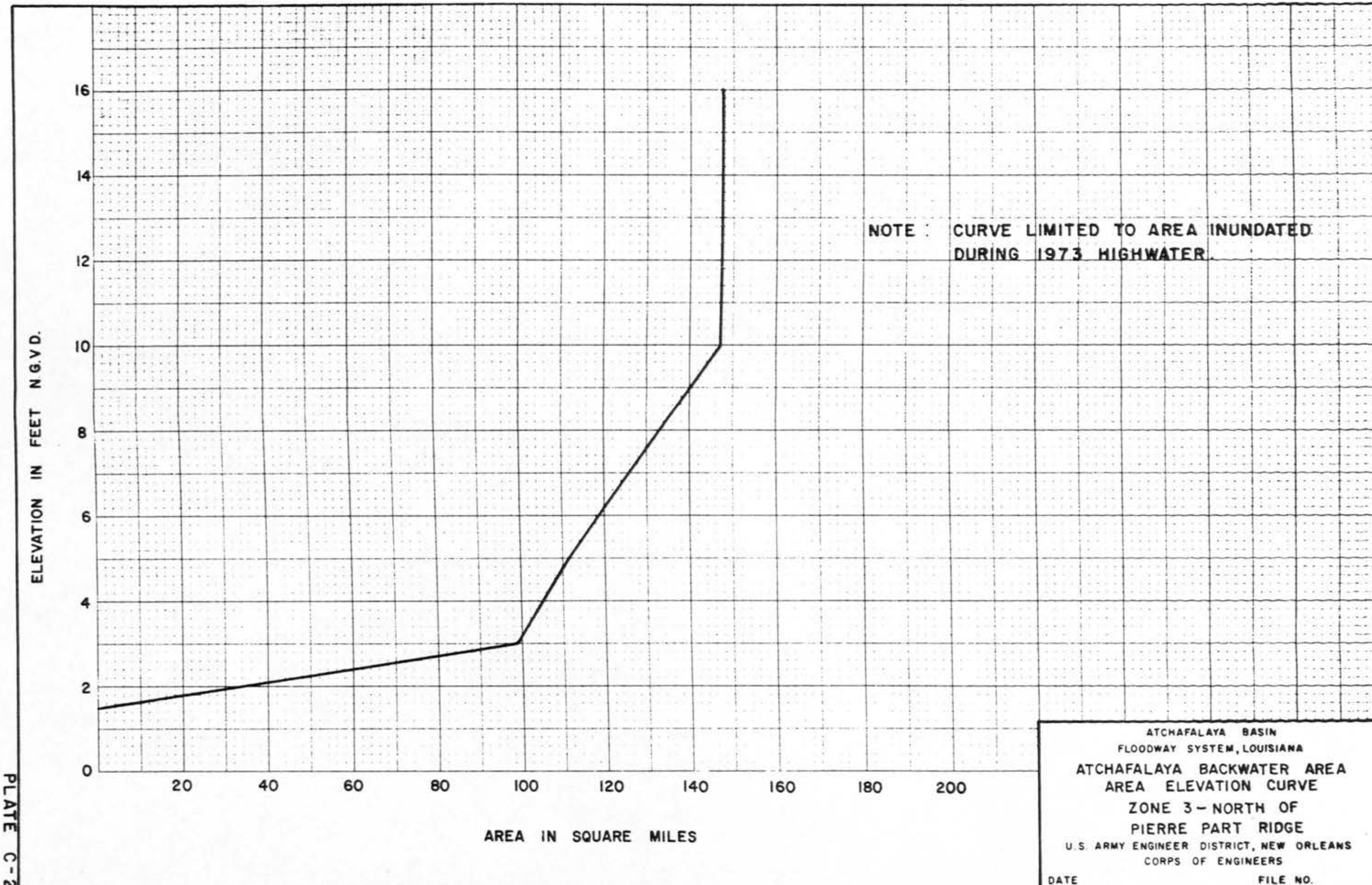


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE 2-LAKE VERRET

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BACKWATER AREA
AREA ELEVATION CURVE
ZONE 3 – NORTH OF
PIERRE PART RIDGE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-23

PLATE C-23

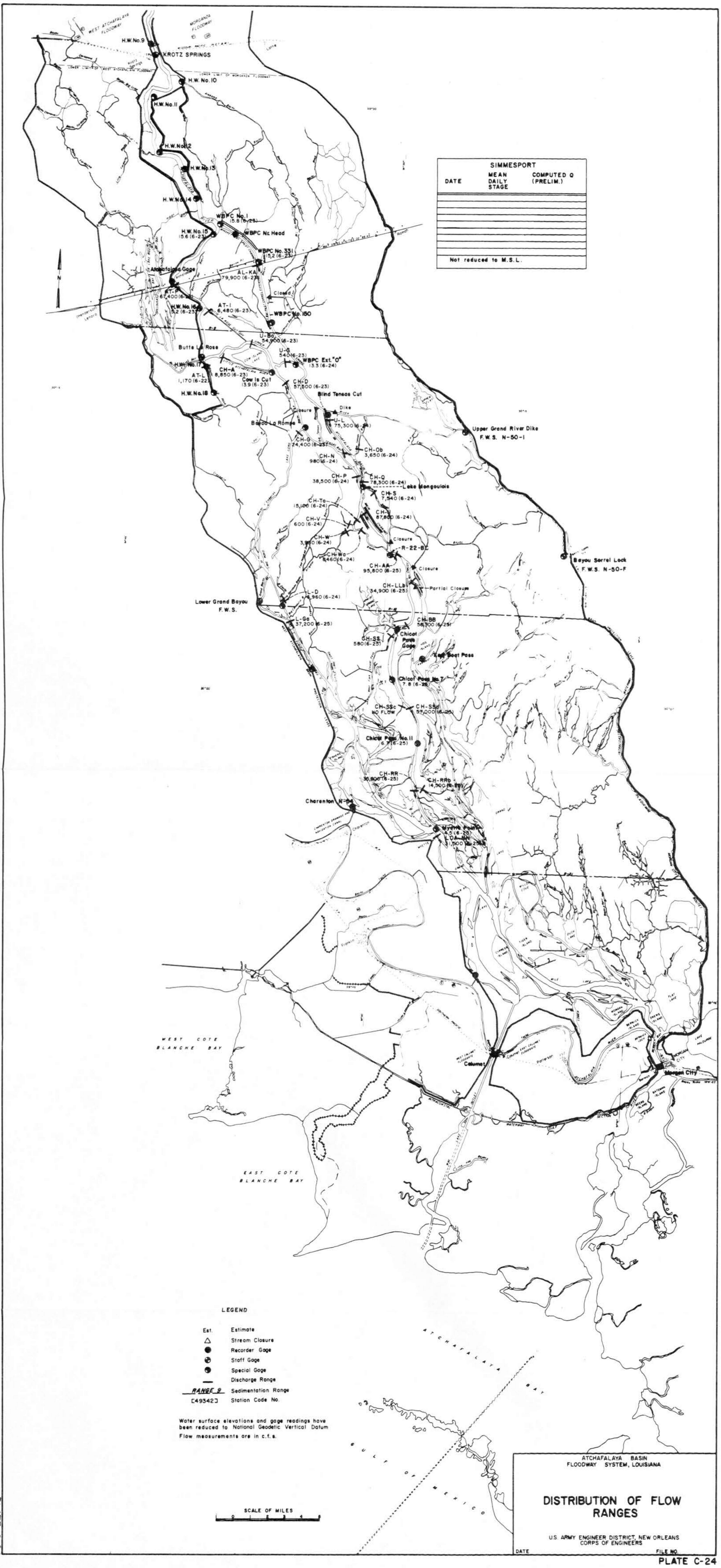
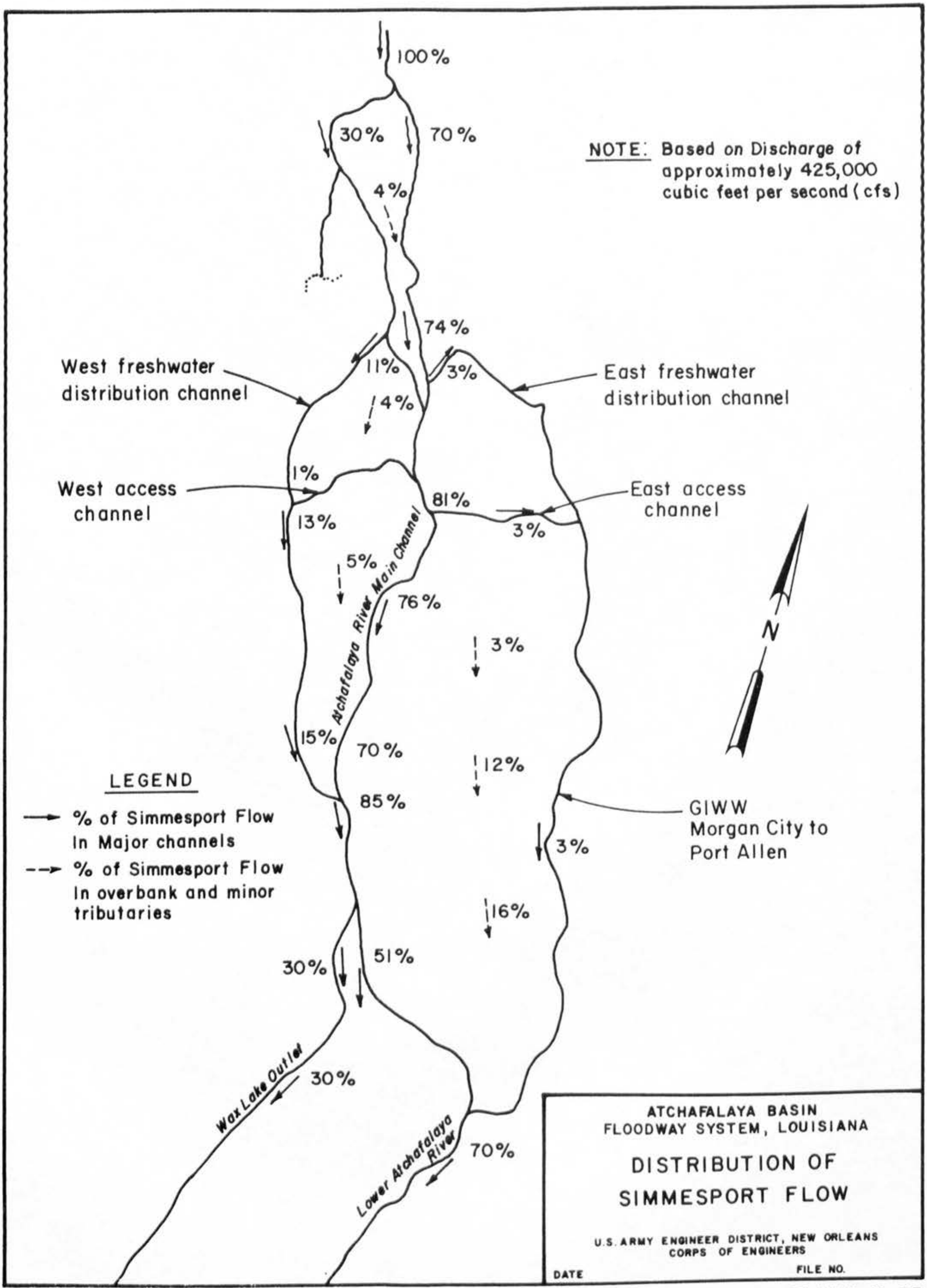
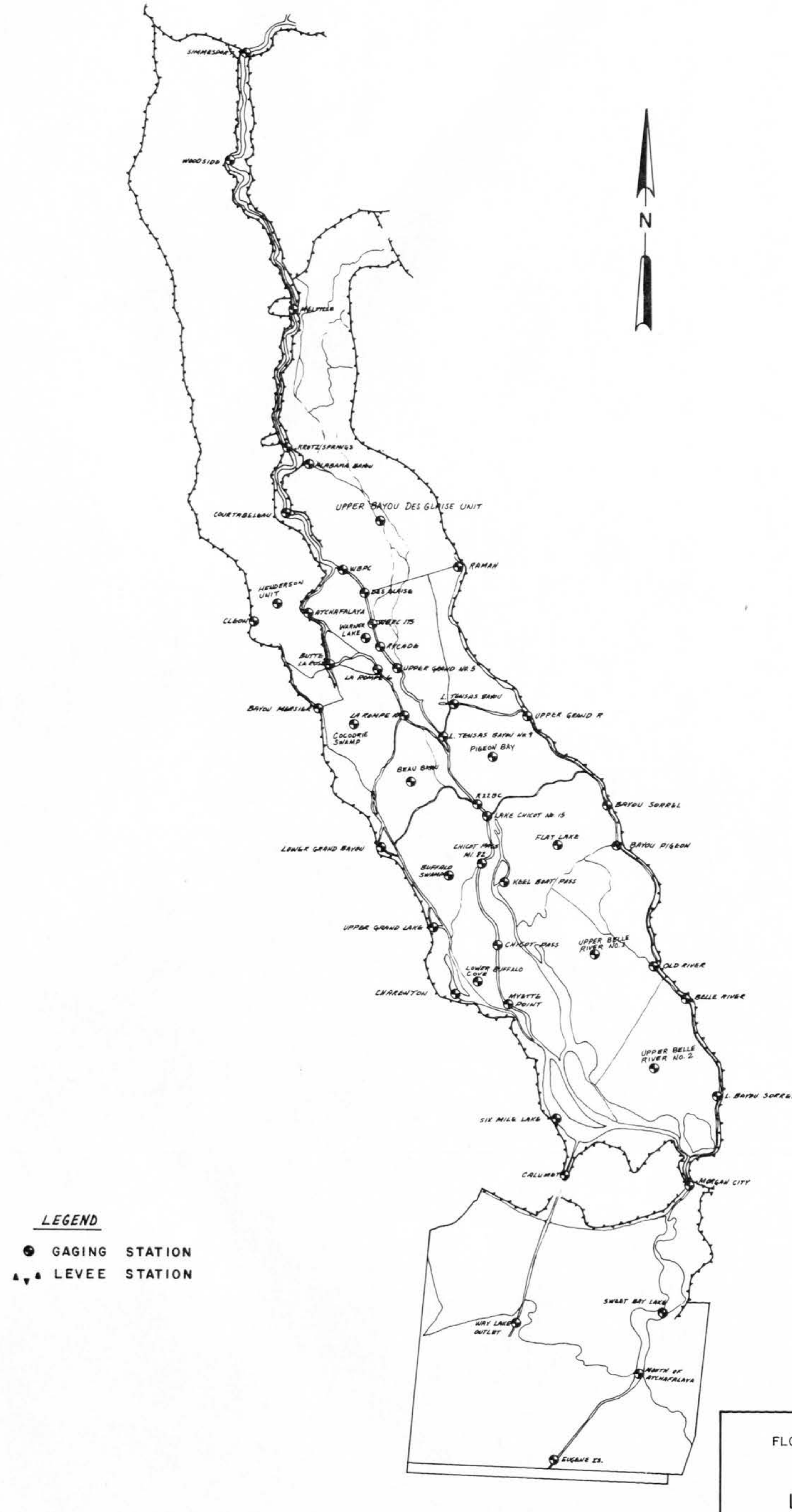

H.W.No.9
KROTZ SPRINGS
H.W. No.10
H.W.No.11
H.W.No.12
H.W.No.13
H.W.No.14
WBPC No.1
15.8 (6-23)
H.W.No.15
15.6 (6-23)
WBPC Nr. Head
WBPC No. 331
15.2 (6-23)
Atchafalaya Gage
AL-KA
79,900 (6-23)
AT-F
67,400 (6-23)
H.W.No.16
15.2 (6-23)
AT-I
6,480 (6-23)
Closed
WBPC No.150
U-Bo
54,900 (6-23)
Butte La Rose
U-G
540 (6-23)
WBPC Ext."O"
13.3 (6-24)
H.W.No.17
AT-L
1,170 (6-22)
CH-A
8,850 (6-23)
Cow Is Cut
13.9 (6-23)
CH-D
57,500 (6-23)
H.W.No.18
Blind Tensas Cut
Dike
Closure
Bayou La Rompe
U-L
75,300 (6-24)
Upper Grand River Dike
F.W.S. N-50-I
CH-G
24,400 (6-23)
CH-Ob
3,650 (6-24)
CH-N
980 (6-24)
CH-P
38,500 (6-24)
CH-Q
78,300 (6-24)
Lake Mongoulois
CH-S
7,540 (6-24)
CH-To
15,100 (6-24)
87,800 (6-24)
CH-V
600 (6-24)
CH-W
Closure
R-22-BC
CH-Wo
CH-AA
95,800 (6-25)
Closure
Bayou Sorrel Lock
F.W.S. N-50-F
CH-LLb
34,900 (6-25)
Partial Closure
L-D
960 (6-24)
Lower Grand Bayou
F.W.S.
L-Go
37,200 (6-25)
CH-BB
56,300 (6-25)
CH-SS
580 (6-25)
Chicot Pass Gage
Chicot Pass No.7
7.8 (6-25)
CH-SSc
NO FLOW
CH-SSd
57,000 (6-25)
Chicot Pass No.11
CH-RR
CH-RRb
14,500 (6-25)
Charenton
Myette Point
Calumet
Patterson
Morgan City
WEST COTE
BLANCHE BAY
EAST COTE
BLANCHE BAY
ATCHAFALAYA BAY
GULF OF MEXICO
SIMMESPORT
DATE
MEAN DAILY STAGE
COMPUTED Q (PRELIM.)
Not reduced to M.S.L.
LEGEND
Est. Estimate
Stream Closure
Recorder Gage
Staff Gage
Special Gage
Discharge Range
RANGE 9 Sedimentation Range
[49342] Station Code No.
Water surface elevations and gage readings have been reduced to National Geodetic Vertical Datum
Flow measurements are in c.f.s.
SCALE OF MILES
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTION OF FLOW
RANGES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-24


100%
30%
70%
NOTE: Based on Discharge of approximately 425,000 cubic feet per second (cfs)
4%
74%
West freshwater distribution channel
11%
3%
East freshwater distribution channel
4%
1%
West access channel
81%
East access channel
13%
3%
5%
Atchafalaya River Main Channel
76%
N
3%
15%
70%
12%
LEGEND
% of Simmesport Flow In Major channels
% of Simmesport Flow In overbank and minor tributaries
85%
GIWW Morgan City to Port Allen
3%
16%
30%
51%
Wax Lake Outlet
30%
Lower Atchafalaya River
70%
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
DISTRIBUTION OF SIMMESPORT FLOW
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
DATE
FILE NO.



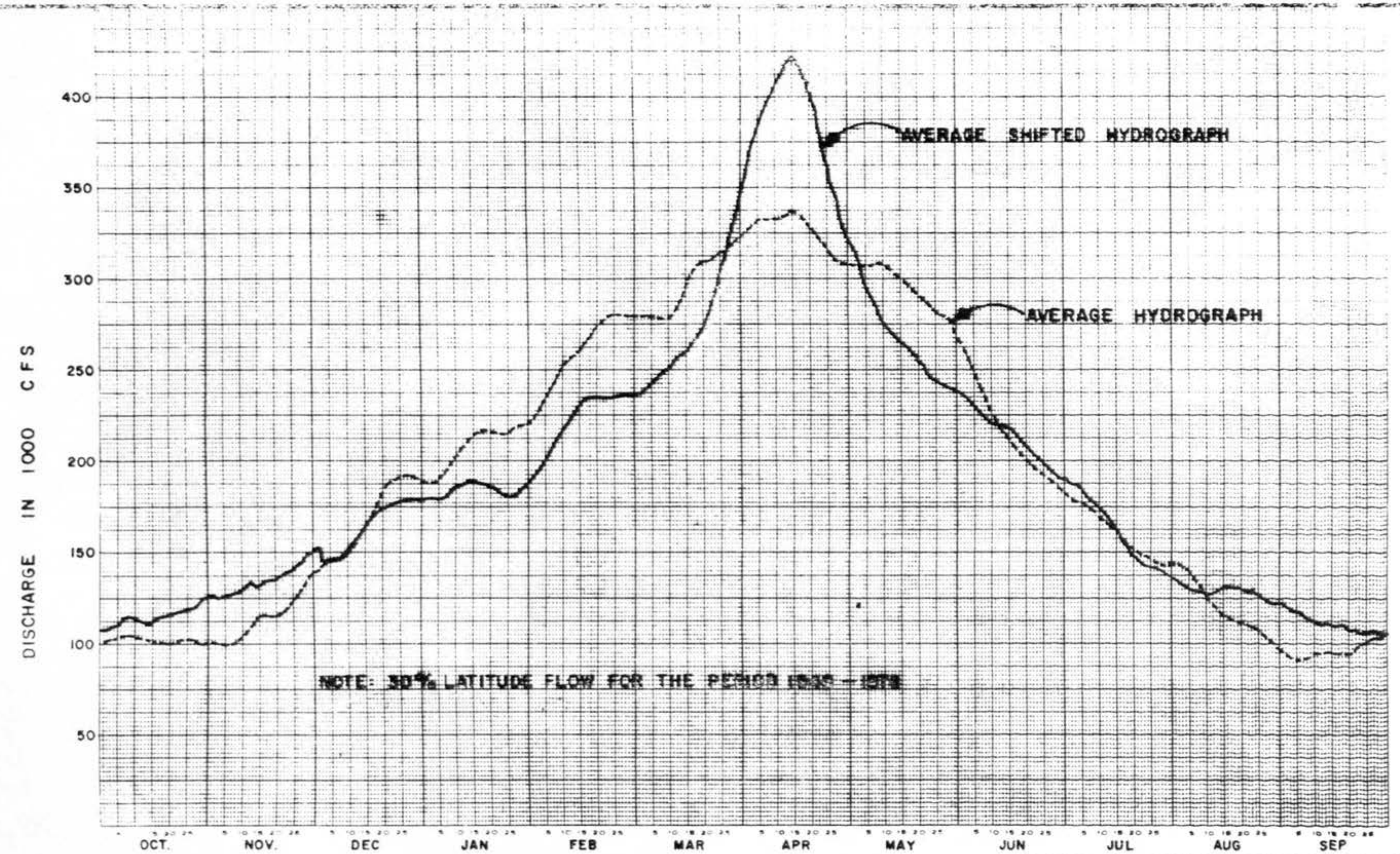
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

MBM GAGES
LOCATION MAP

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-26



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA RIVER DISCHARGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-27

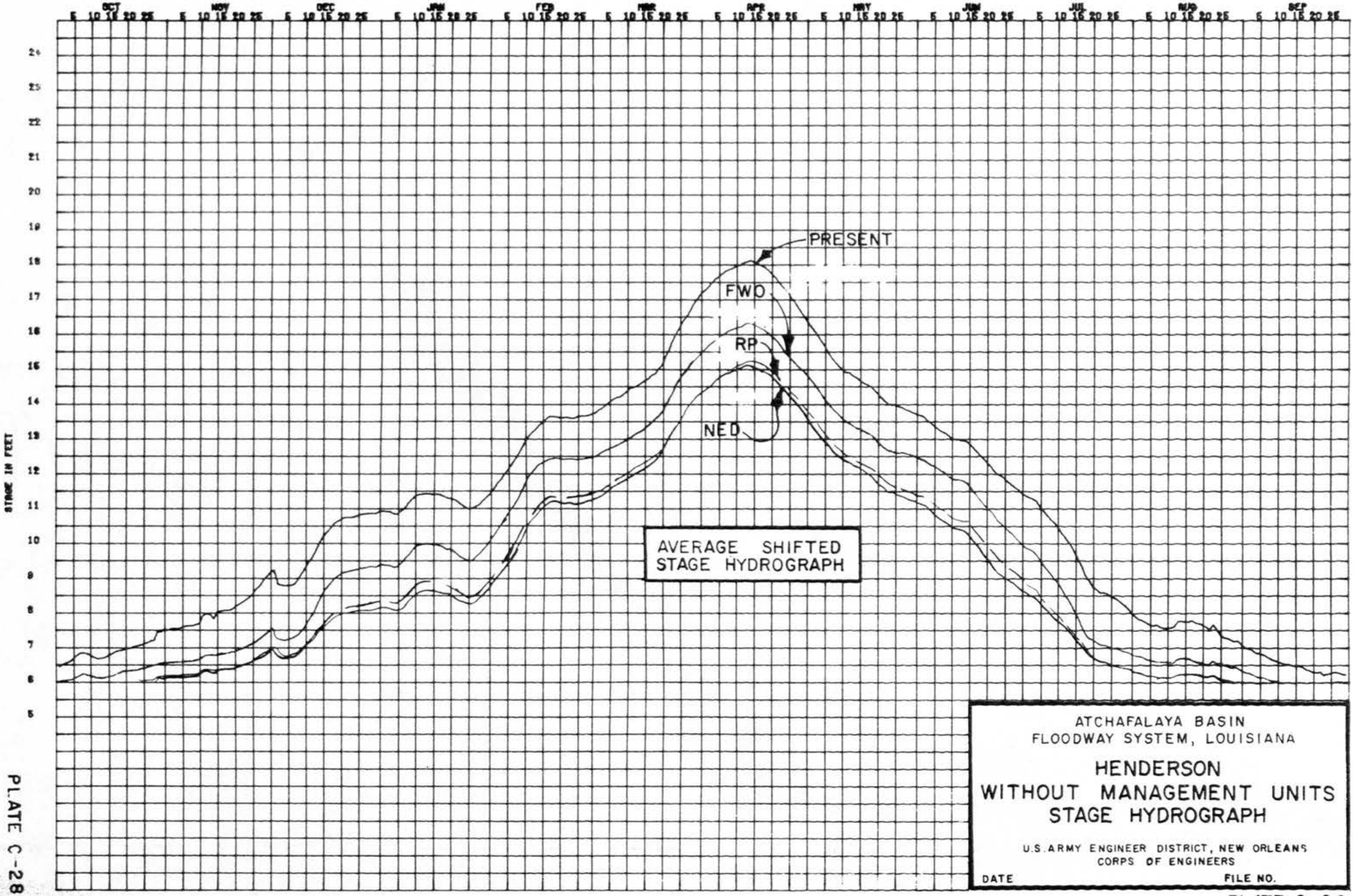
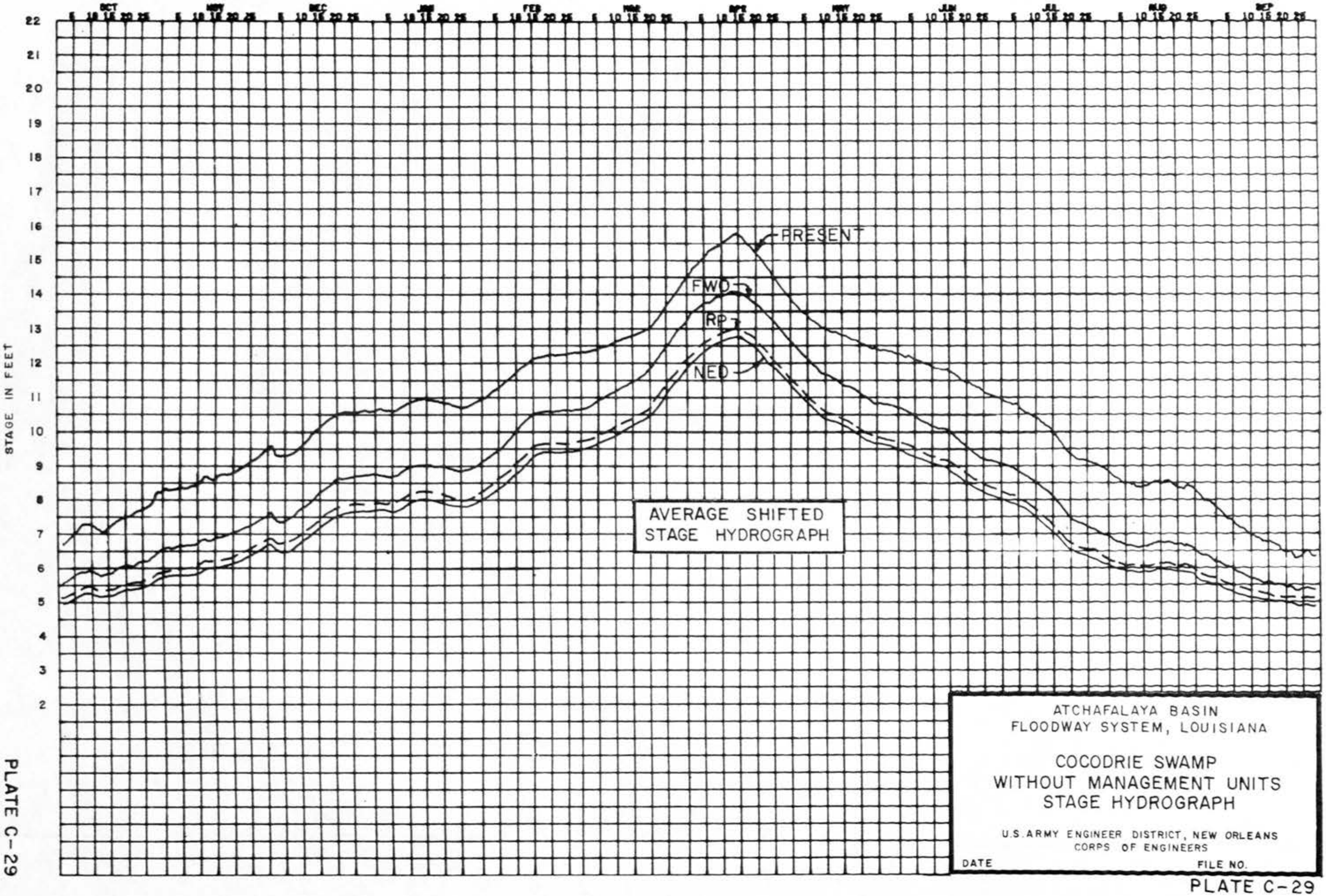


PLATE C-28

PLATE C-28



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

COCODRIE SWAMP
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-29

PLATE C-29

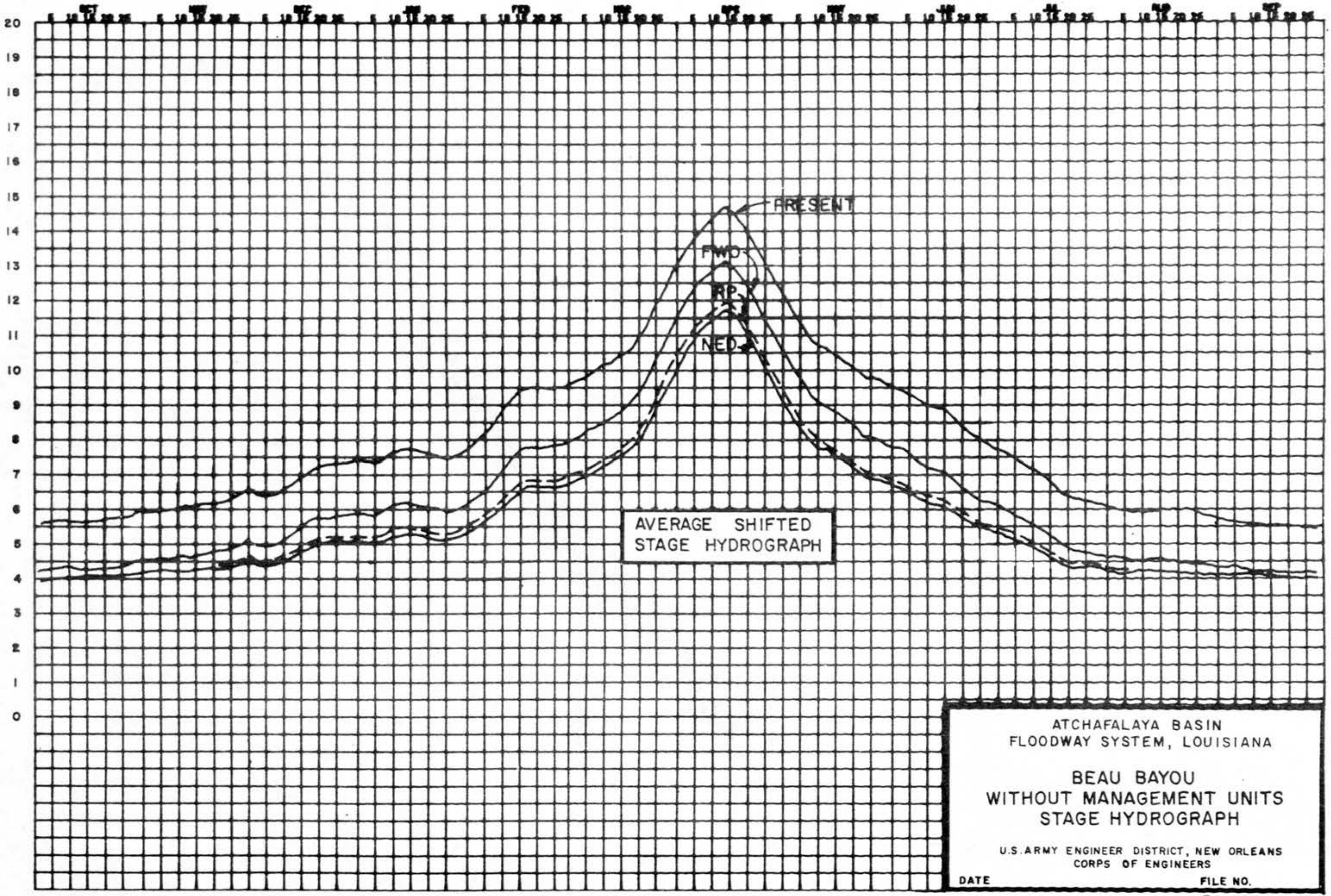
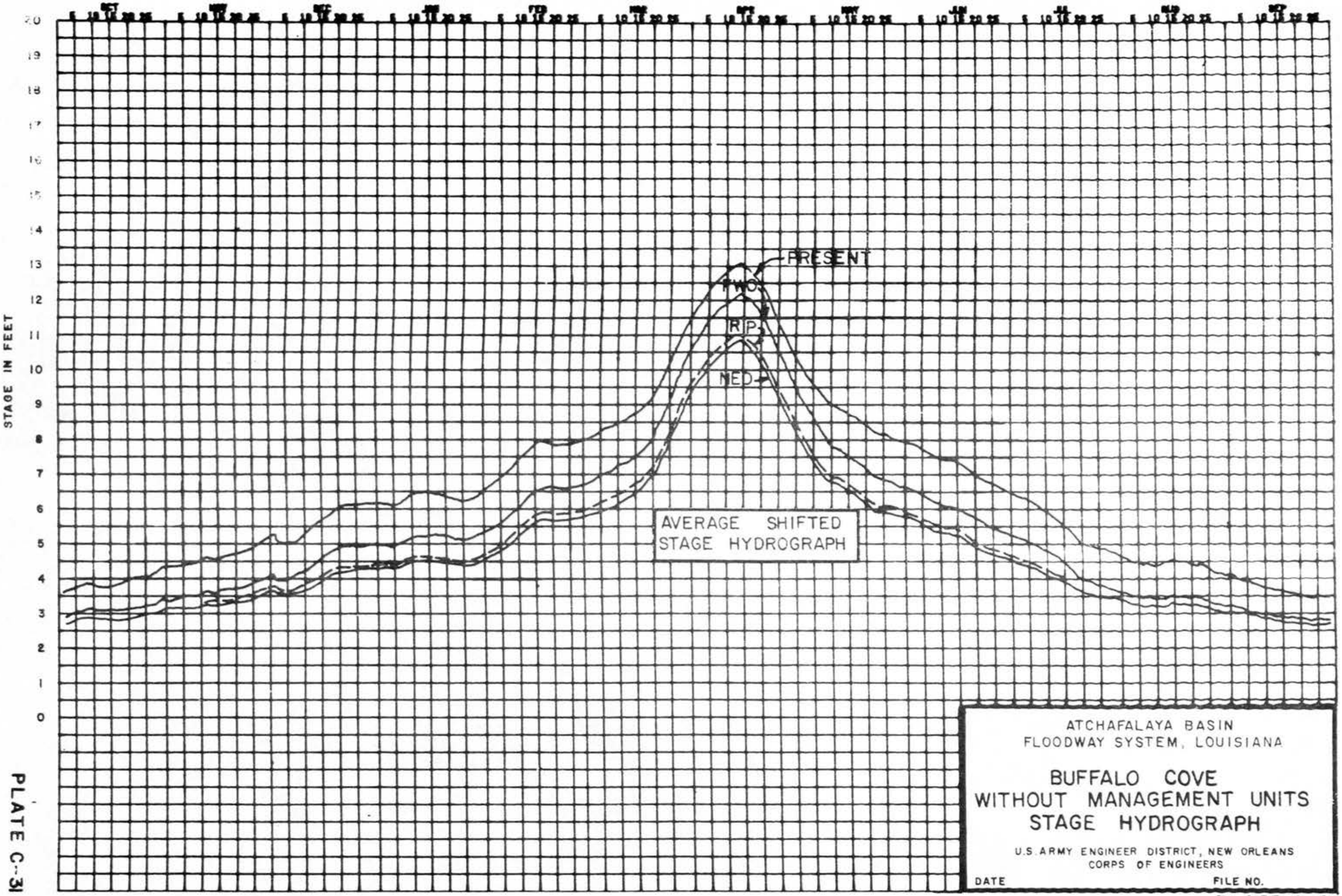

STAGE IN FEET
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
PRESENT
FWO
RP
NED
AVERAGE SHIFTED
STAGE HYDROGRAPH
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
BEAU BAYOU
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-30



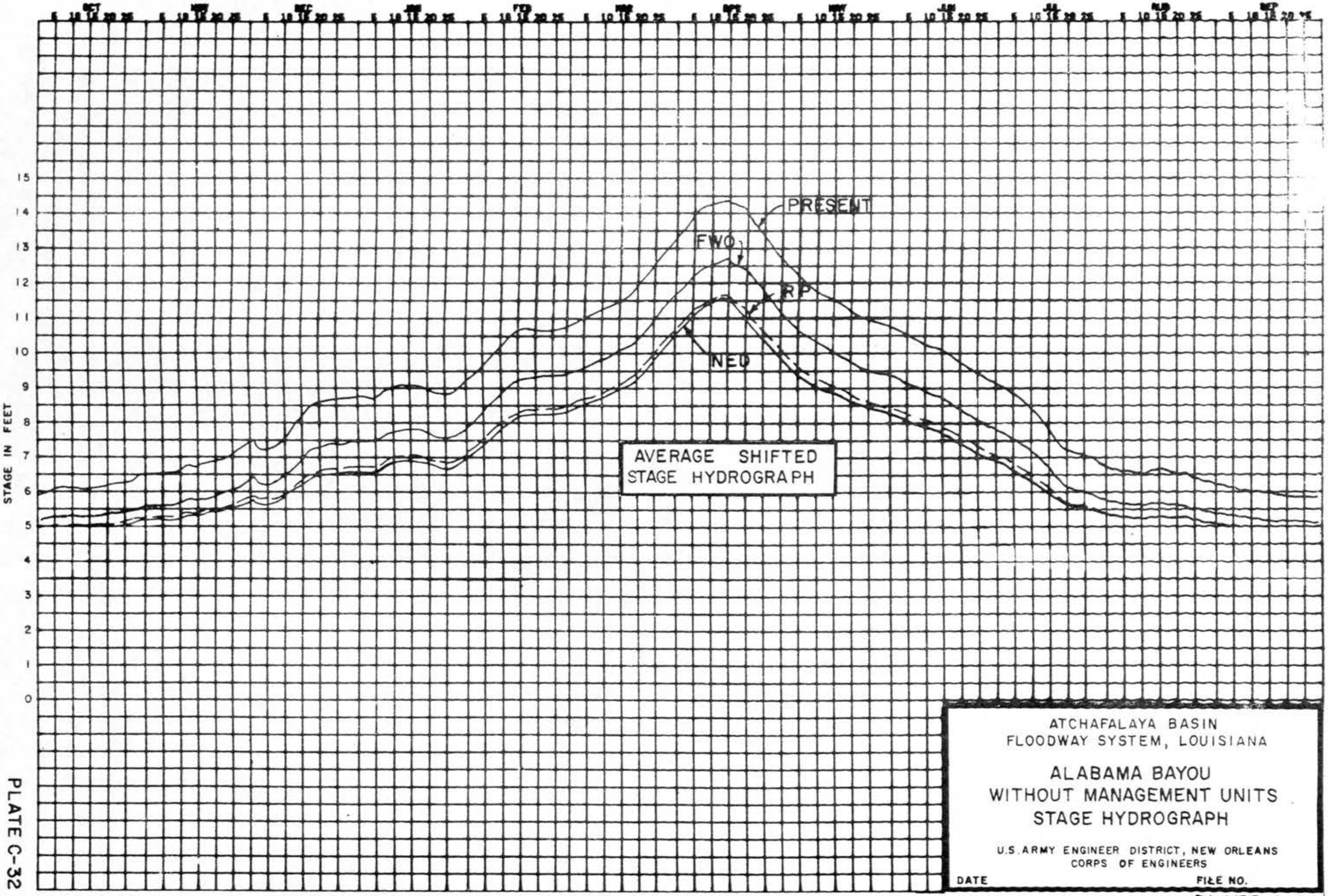
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BUFFALO COVE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-31



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

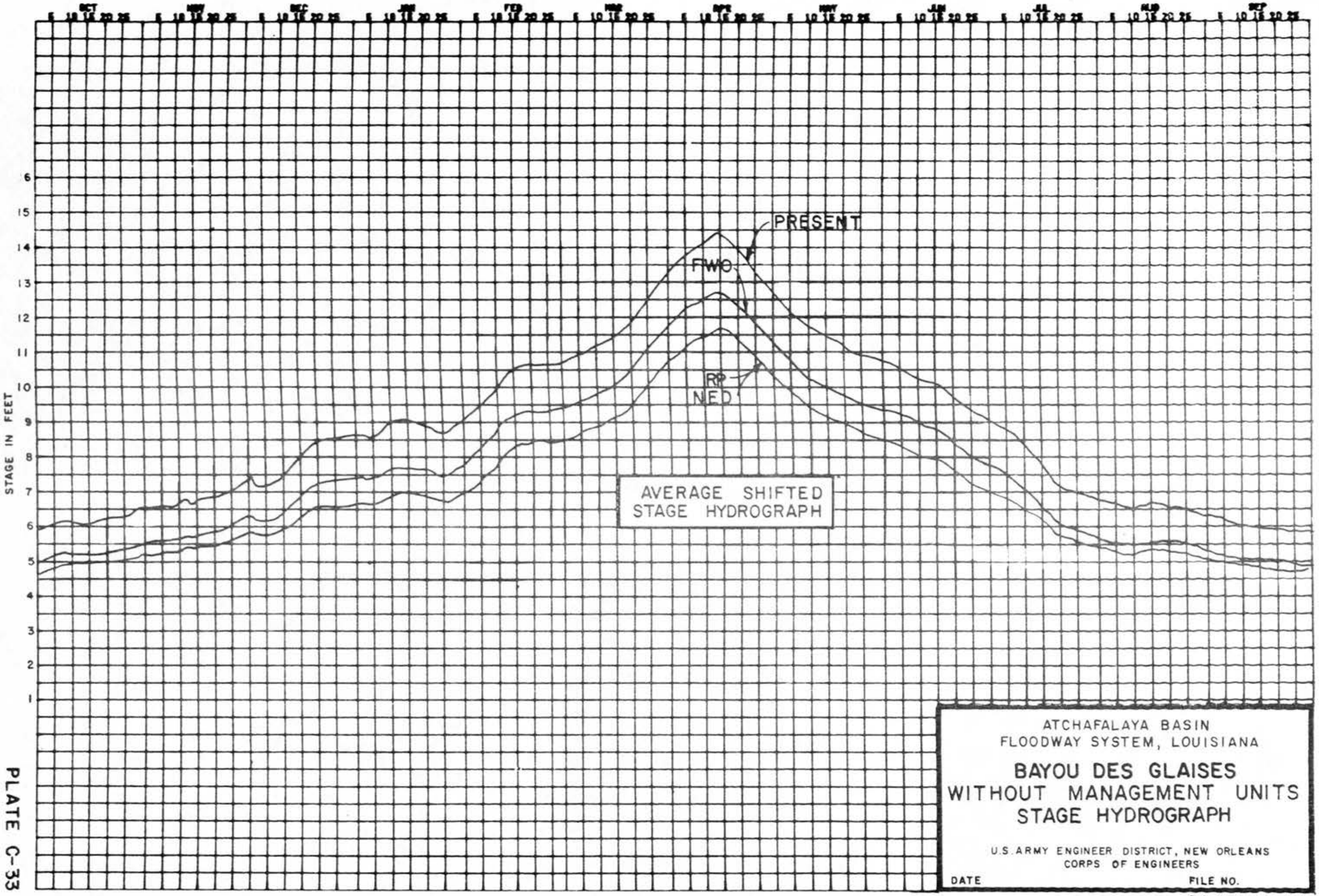
ALABAMA BAYOU
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-32

PLATE C-32



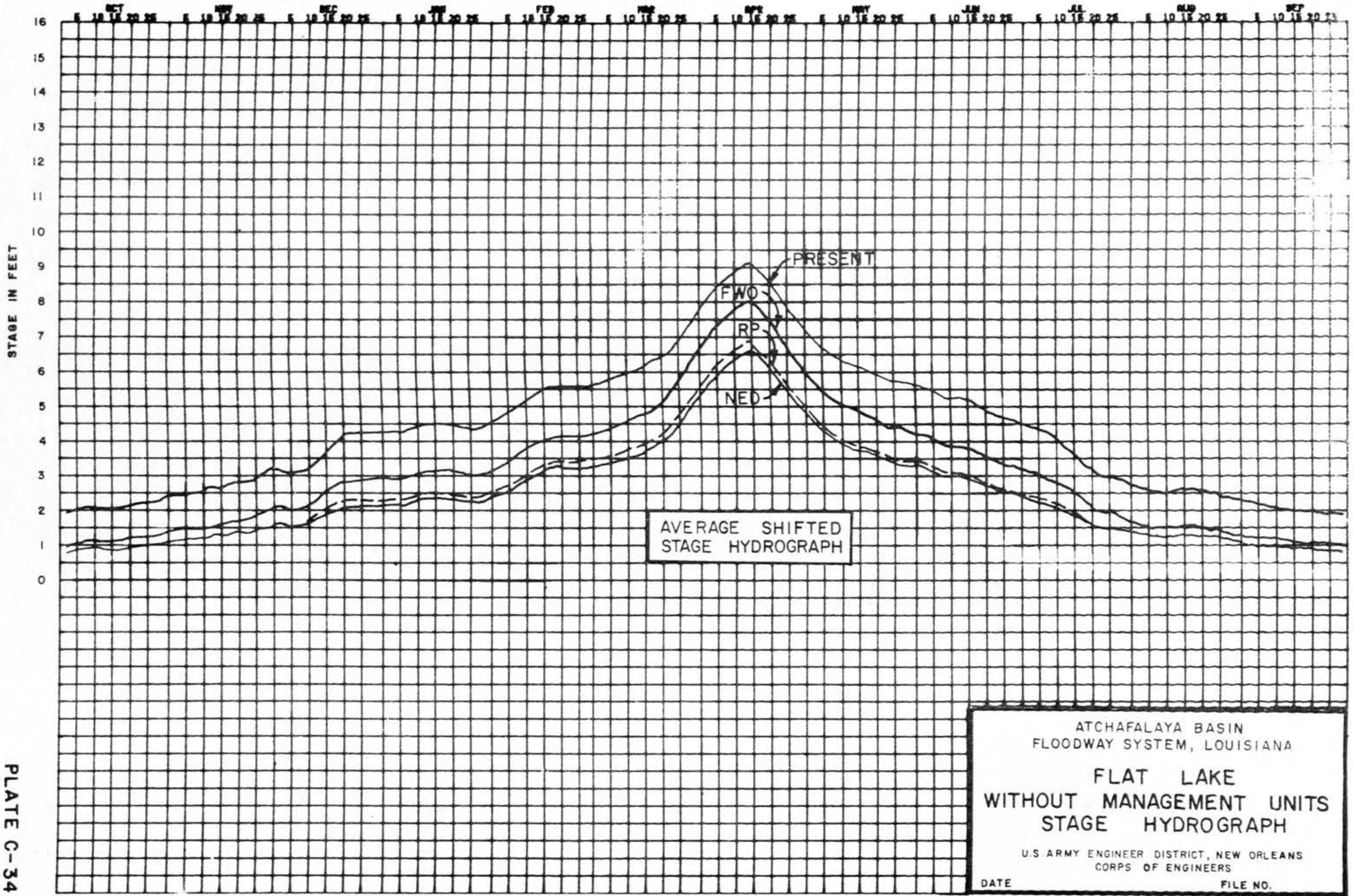
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

**BAYOU DES GLAISES
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH**

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-33



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

FLAT LAKE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

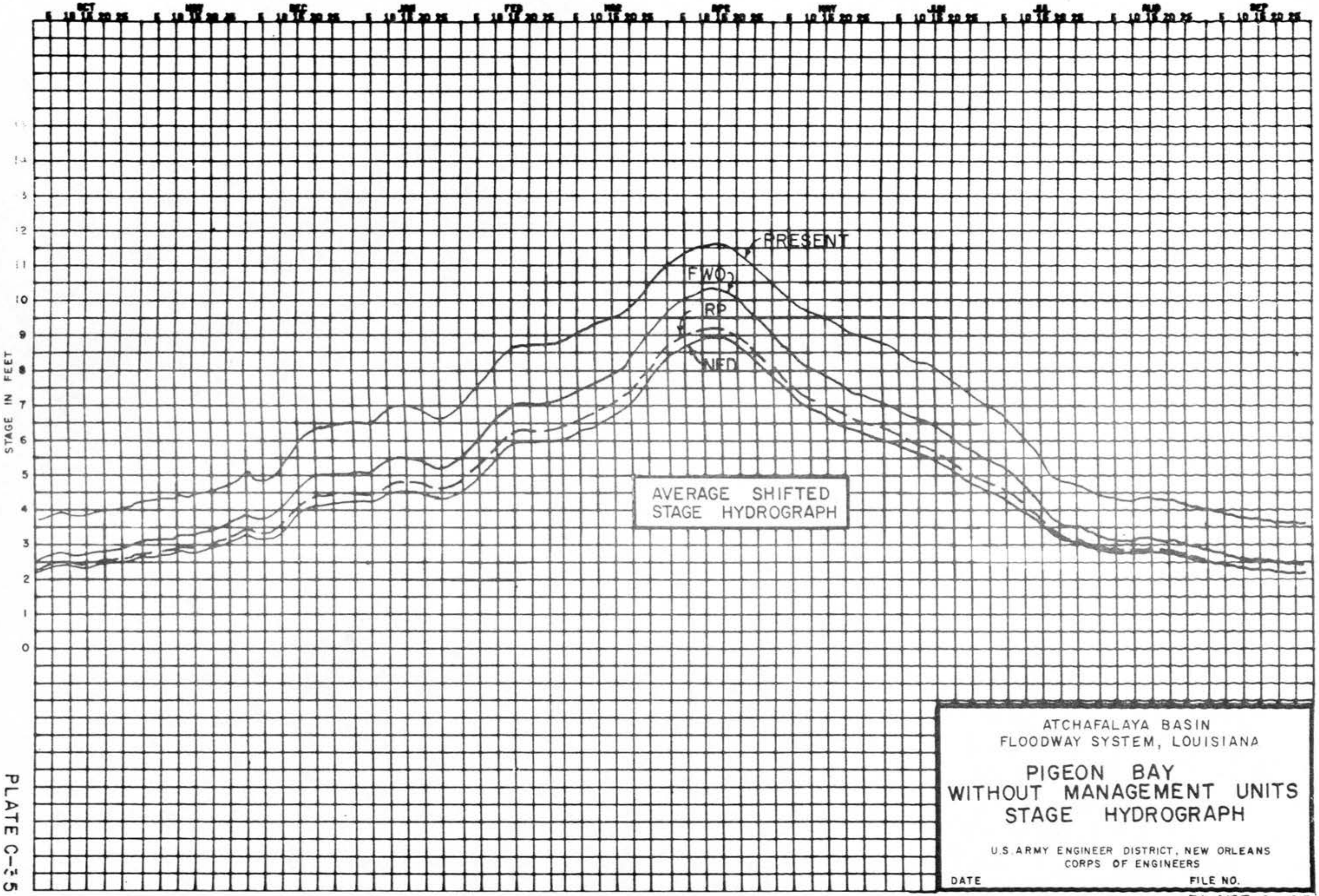
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE

FILE NO.

PLATE C-34

PLATE C-34



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

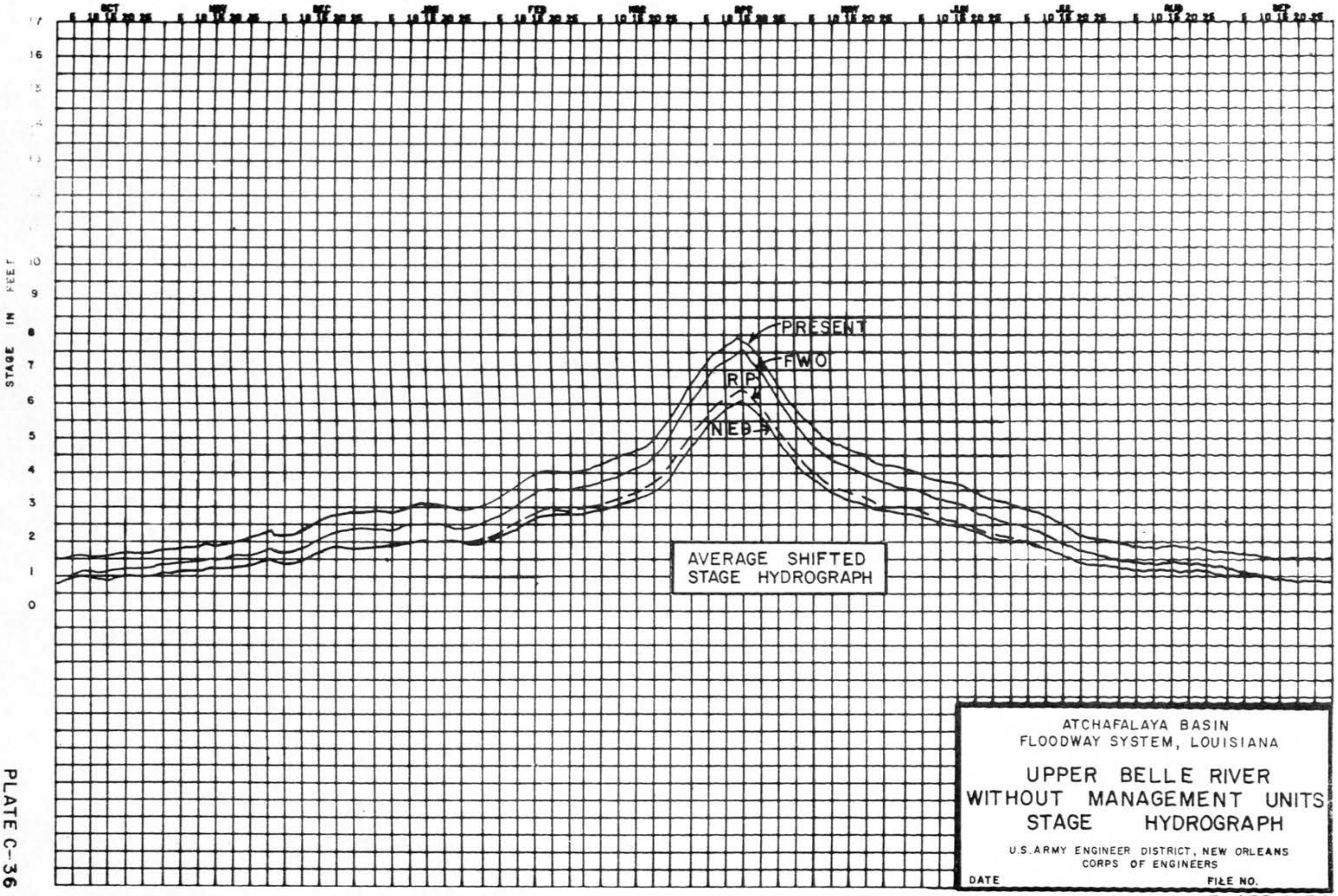
PIGEON BAY
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-35

PLATE C-35



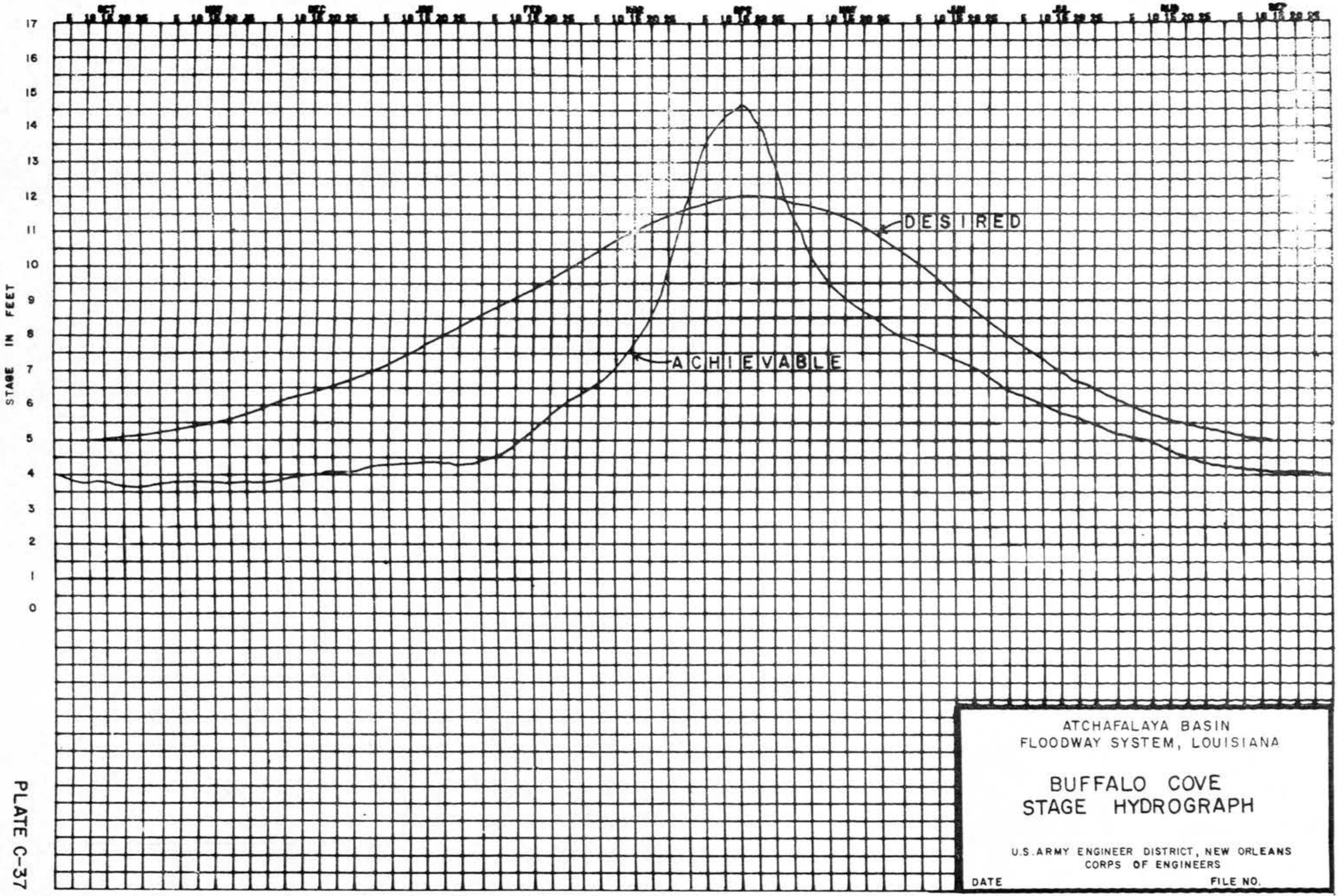
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

UPPER BELLE RIVER
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-36



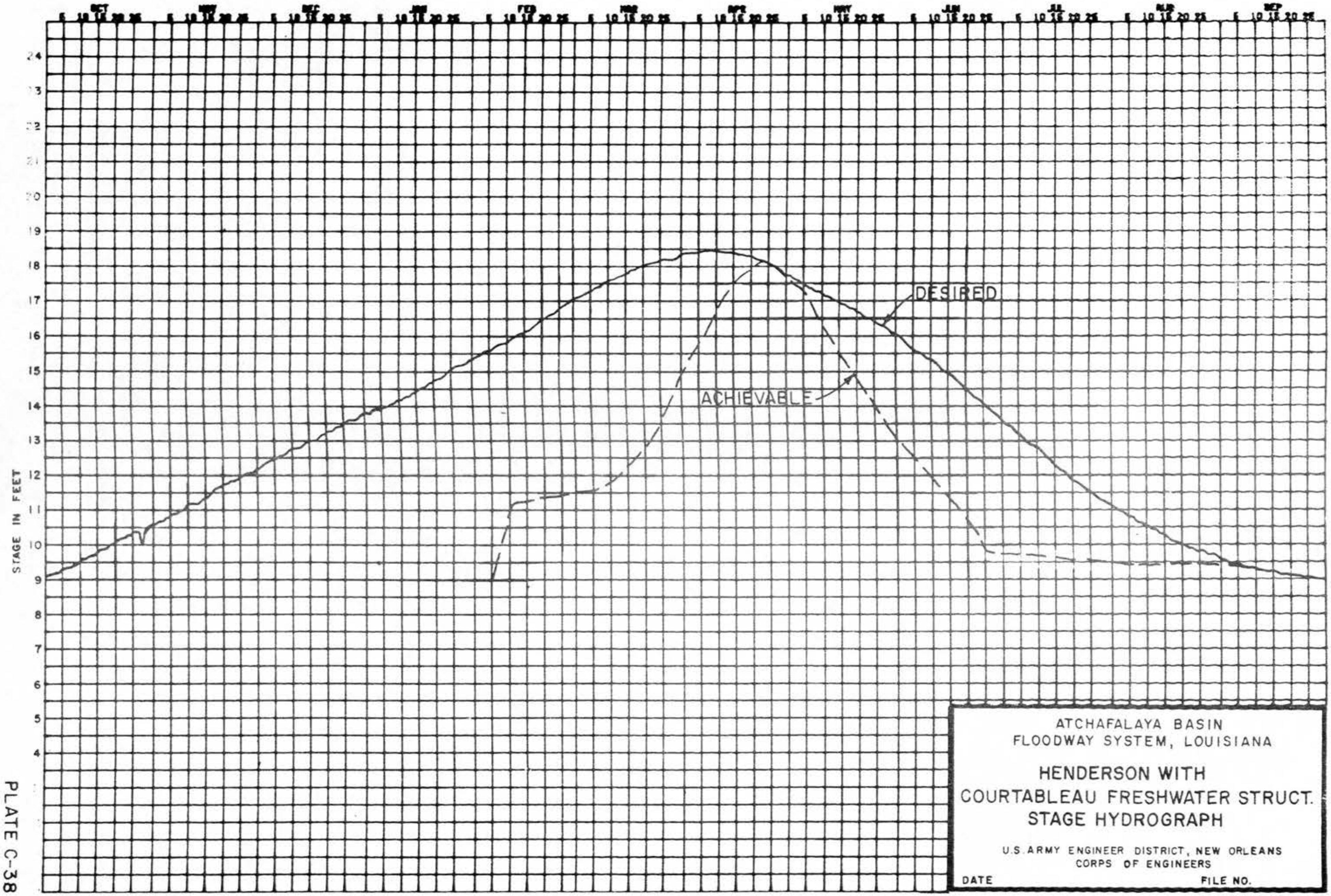
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BUFFALO COVE
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-37



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

HENDERSON WITH
COURTABLEAU FRESHWATER STRUCT.
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-38

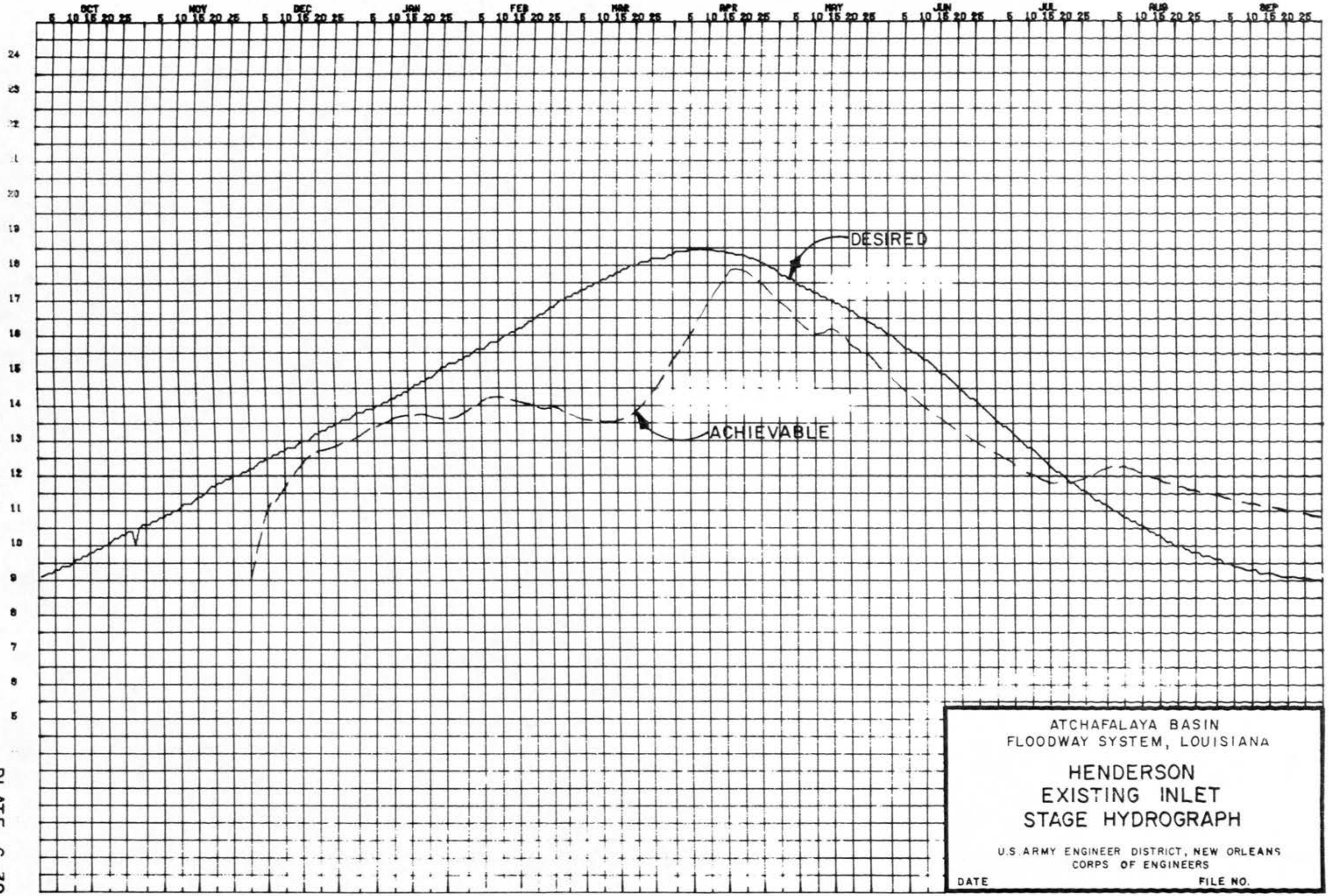
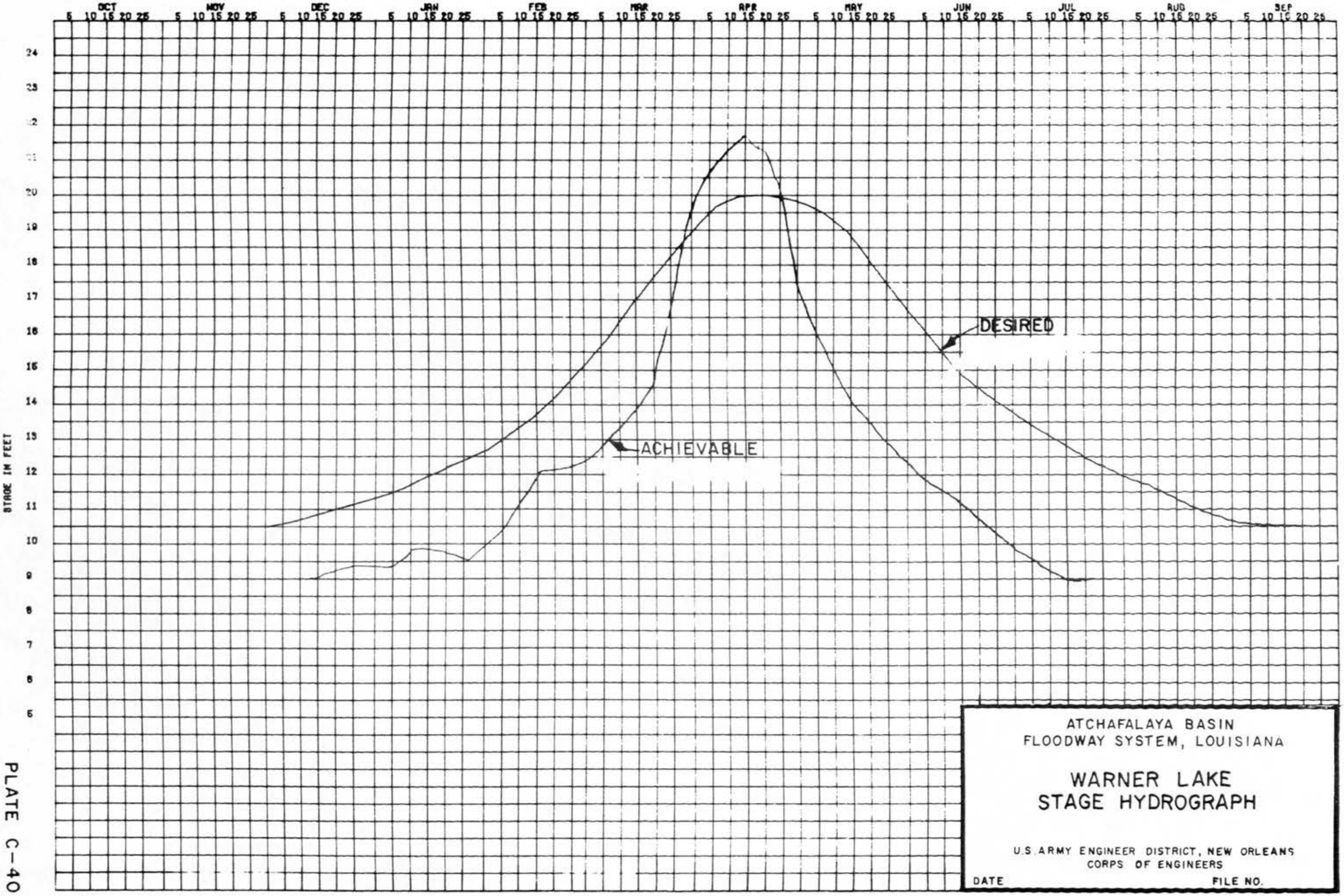


PLATE C-39

PLATE C-39



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

WARNER LAKE
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-40

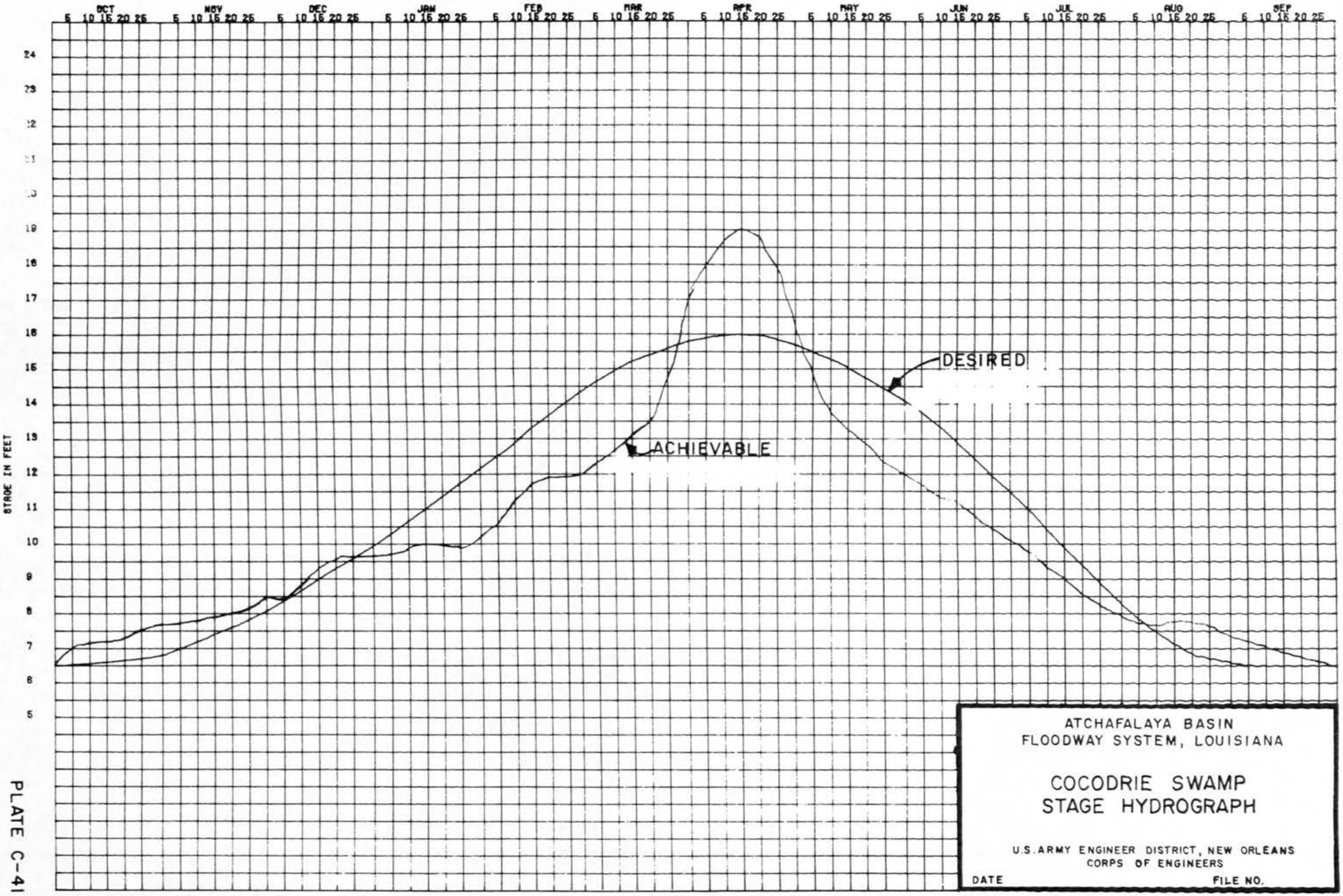
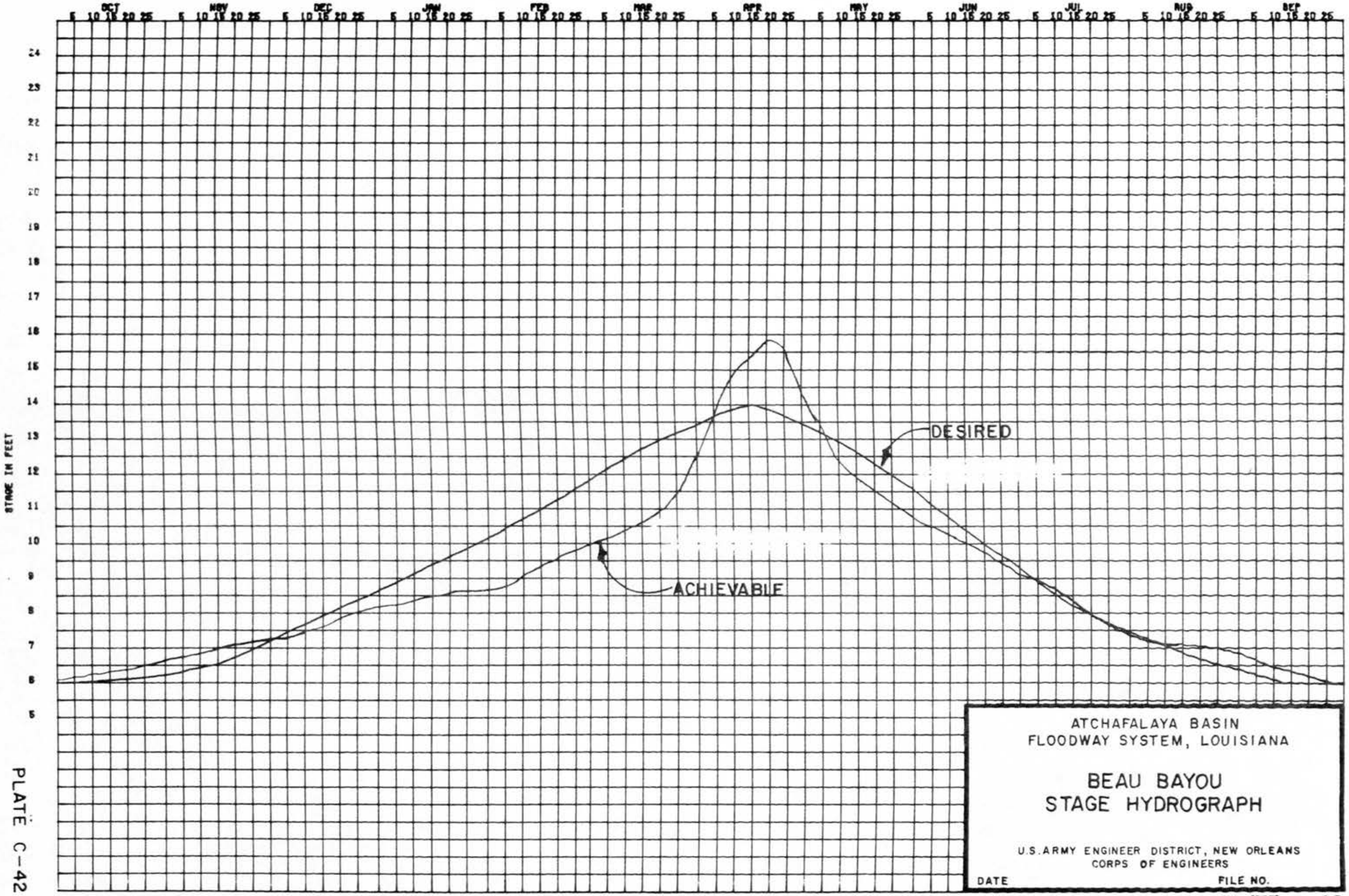


PLATE C-41

PLATE C-41



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

BEAU BAYOU
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-42

PLATE C-42

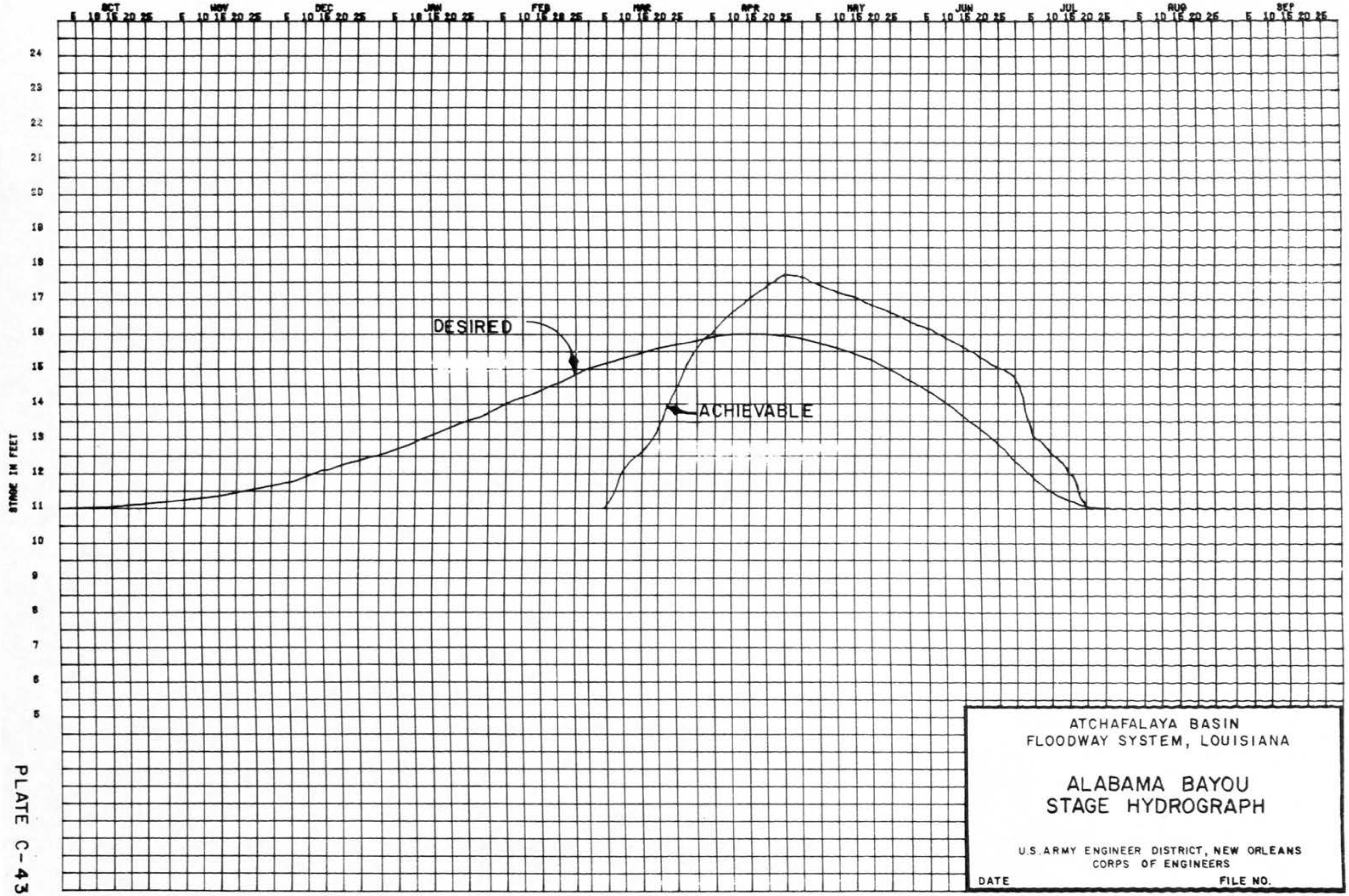


PLATE C-43

PLATE C-43

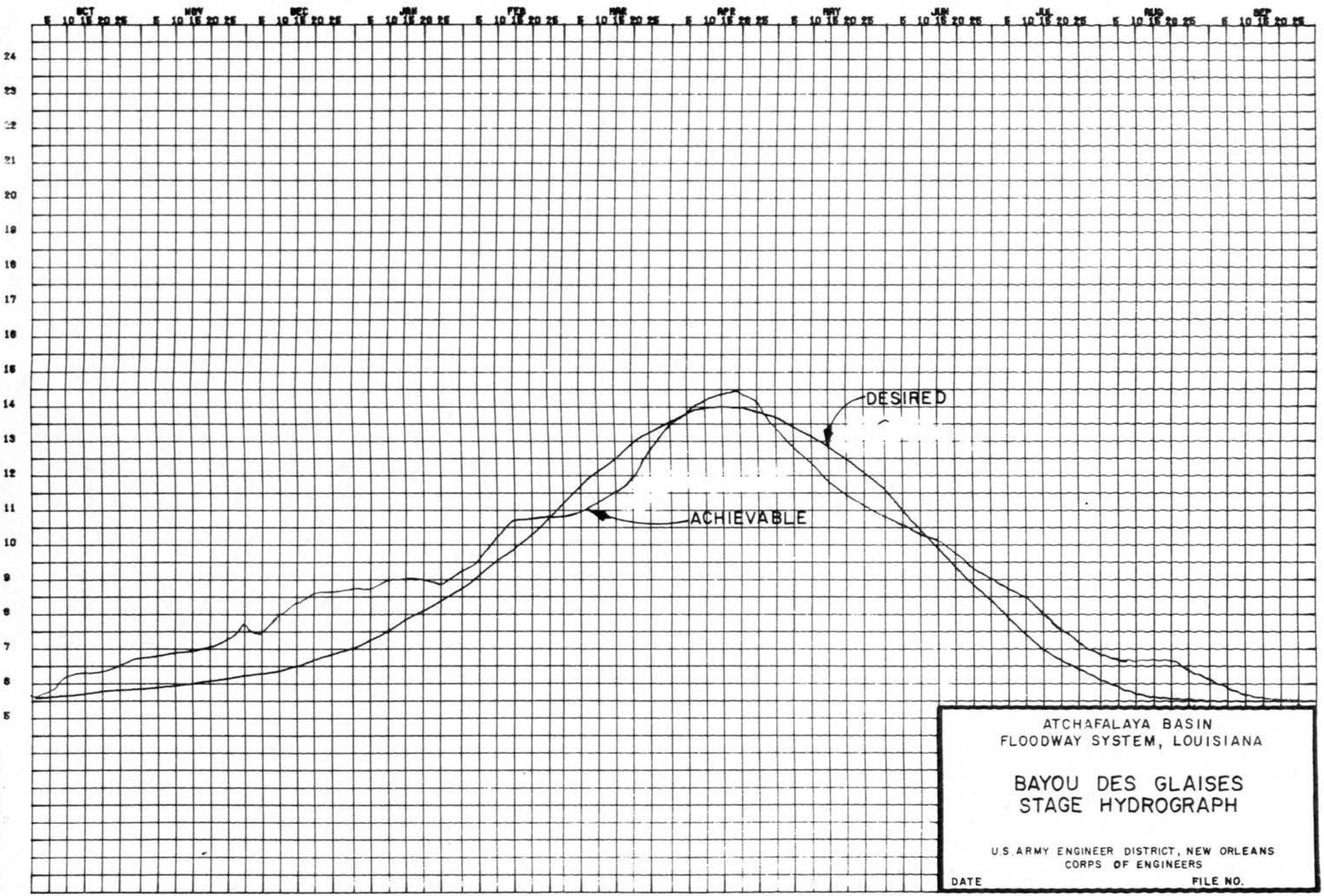
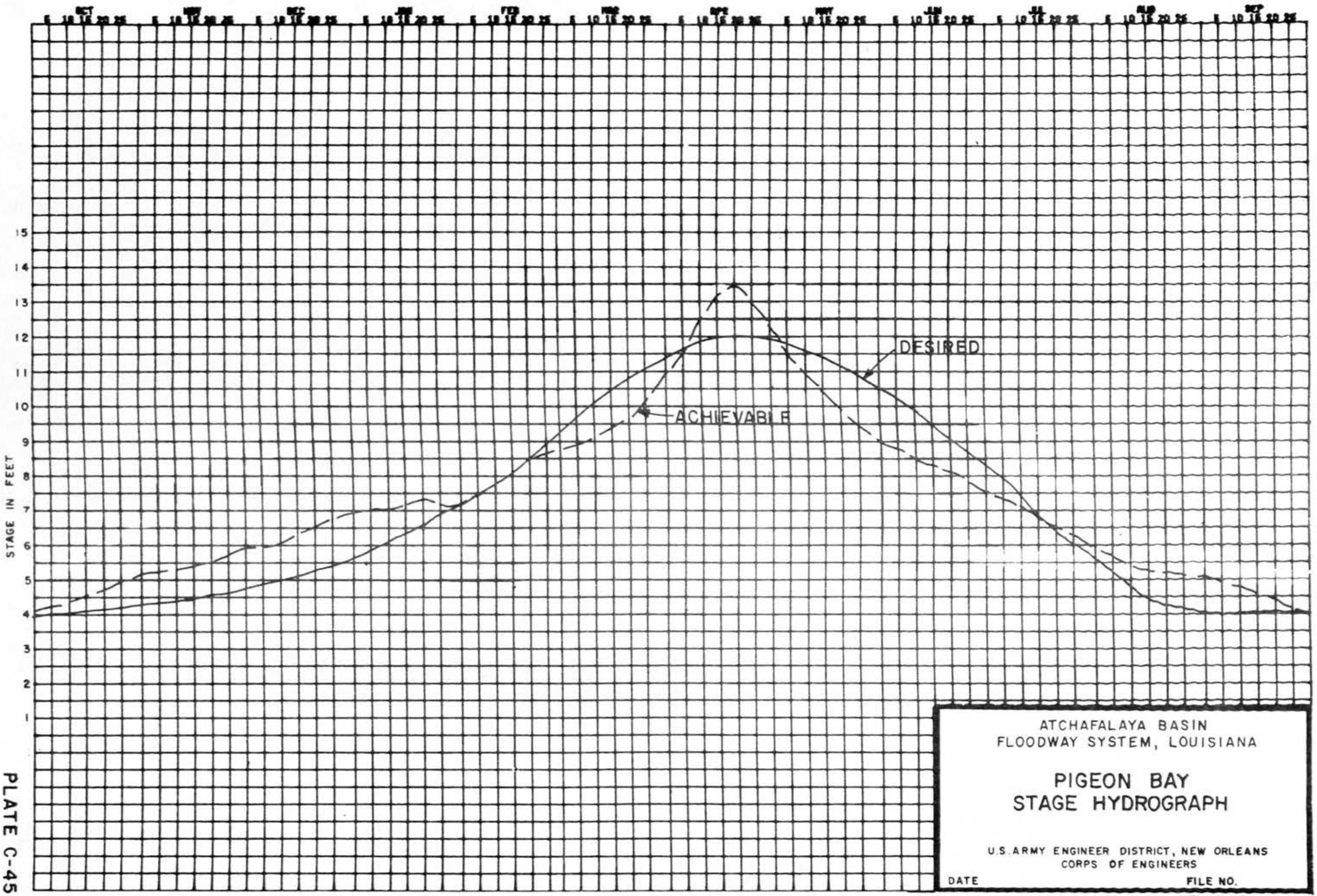


PLATE C-44

PLATE C-44



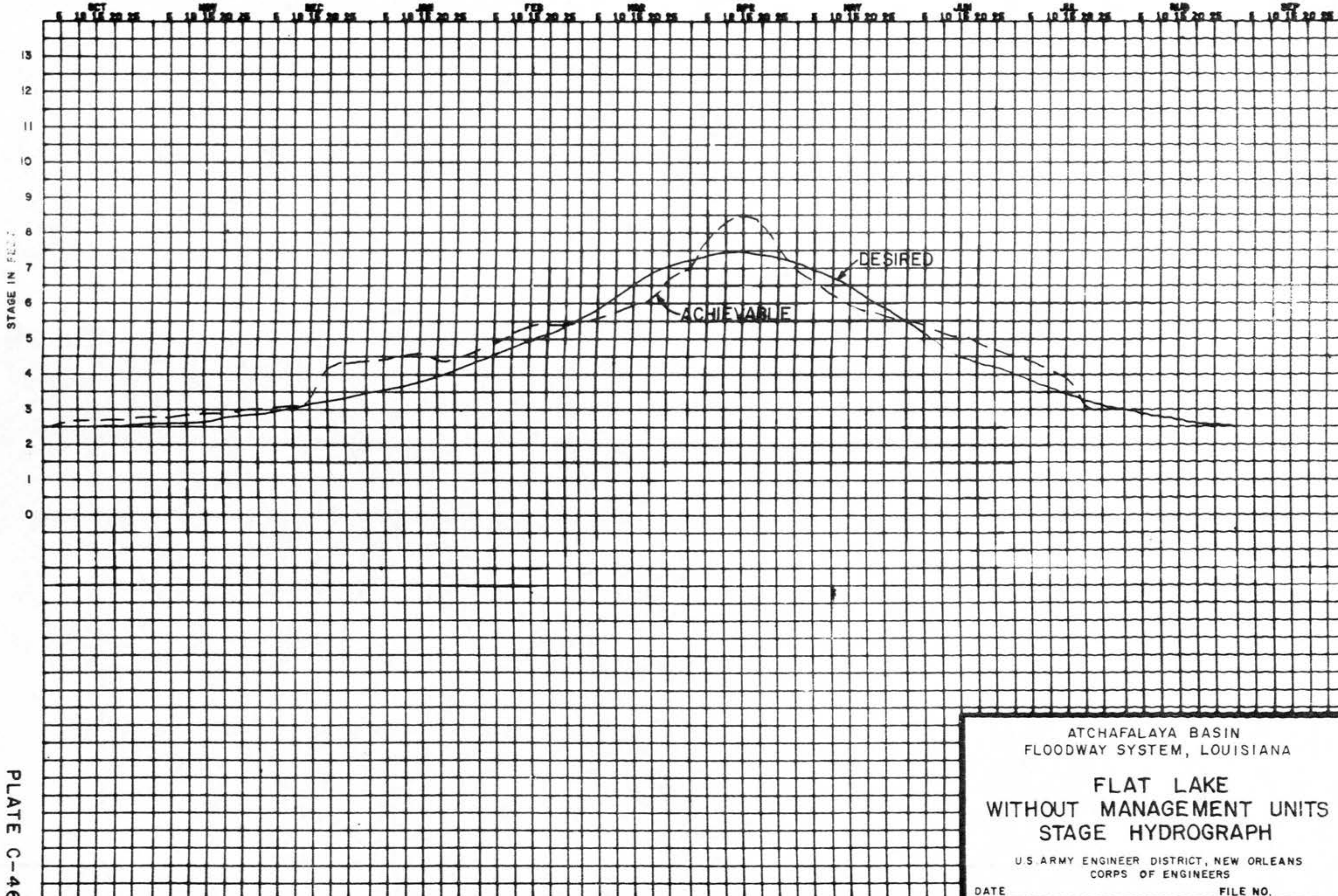
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

PIGEON BAY
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-45



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

FLAT LAKE
WITHOUT MANAGEMENT UNITS
STAGE HYDROGRAPH

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-46

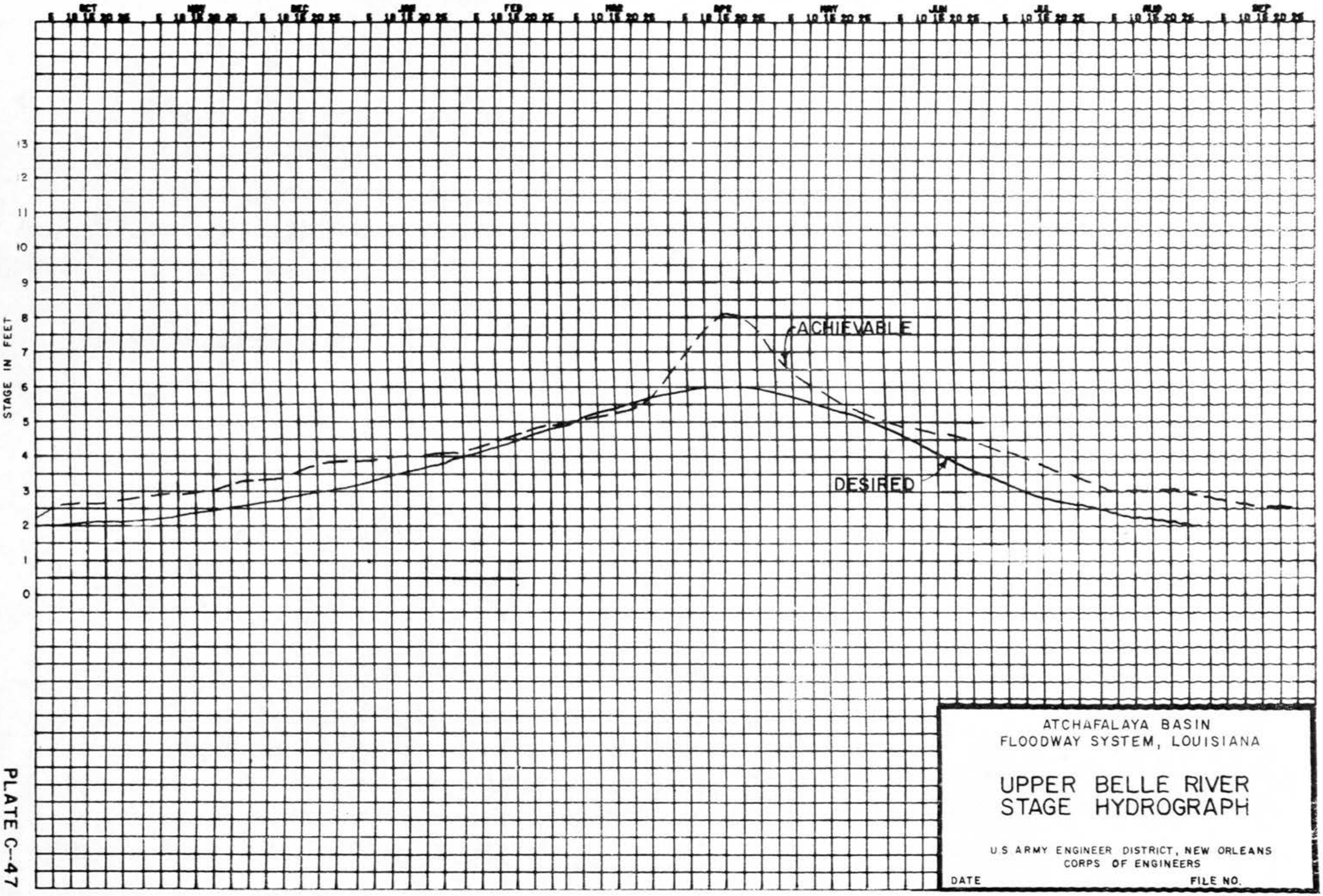
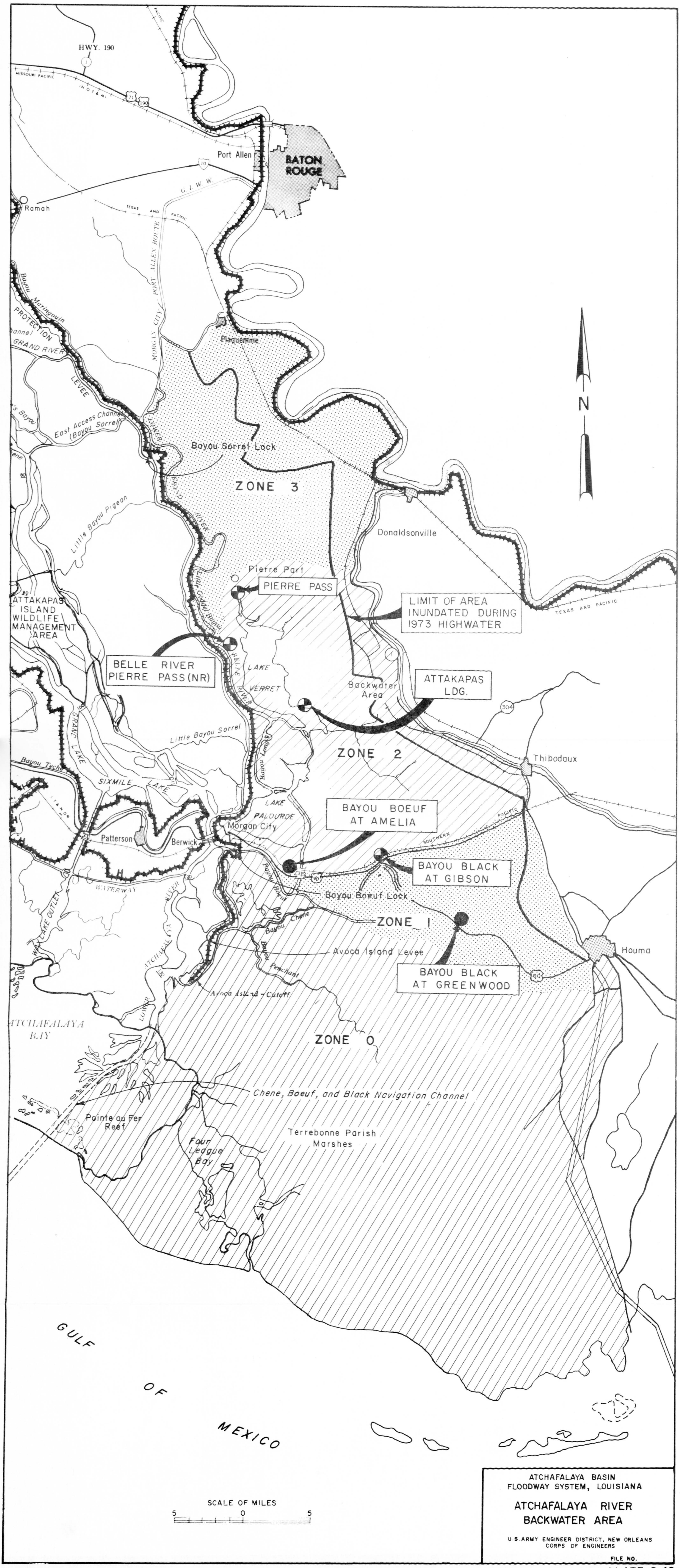
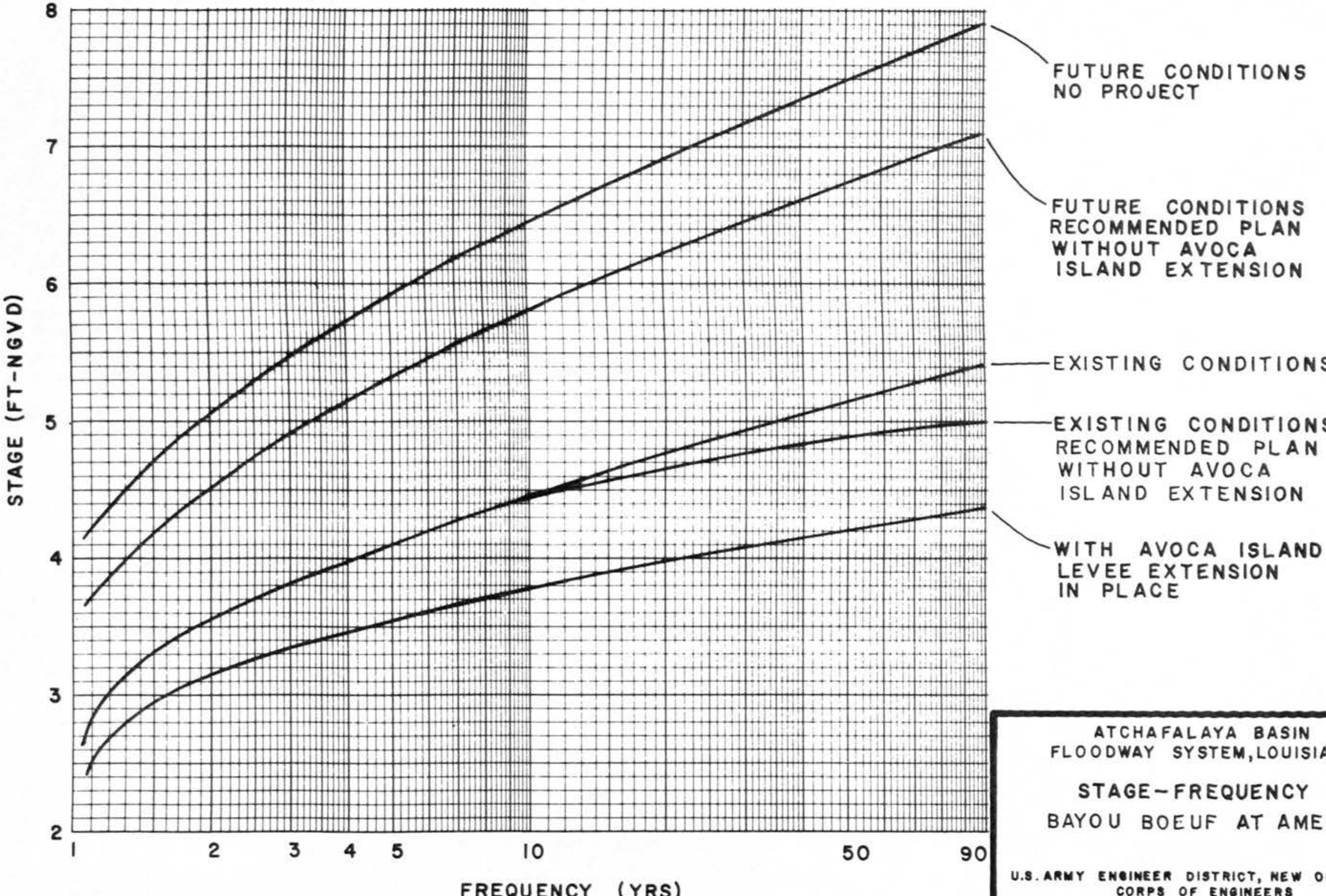

STAGE IN FEET
ACHIEVABLE
DESIRED
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
UPPER BELLE RIVER
STAGE HYDROGRAPH
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-47



HWY. 190
Port Allen
BATON ROUGE
Ramah
G.I.W.W.
TEXAS AND PACIFIC
MORGAN CITY - PORT ALLEN ROUTE
Plaquemine
Bayou Maringouin
PROTECTION
GRAND RIVER
LEVEE
East Access Channel (Bayou Sorrel)
Bayou Sorrel Lock
ZONE 3
Little Bayou Pigeon
Donaldsonville
Pierre Part
PIERRE PASS
LIMIT OF AREA INUNDATED DURING 1973 HIGHWATER
ATTAKAPAS ISLAND WILDLIFE MANAGEMENT AREA
BELLE RIVER PIERRE PASS (NR)
LAKE VERRET
Backwater Area
ATTAKAPAS LDG.
Thibodaux
Little Bayou Sorrel
ZONE 2
Bayou Teche
GRAND LAKE
SIXMILE LAKE
LAKE PALOURDE
Morgan City
BAYOU BOEUF AT AMELIA
Patterson
Berwick
SOUTHERN PACIFIC
BAYOU BLACK AT GIBSON
WATERWAY
Bayou Boeuf Lock
ZONE 1
Bayou Chene
Avoca Island Levee
Houma
Bayou Penchant
BAYOU BLACK AT GREENWOOD
Avoca Island - Cutoff
ATCHAFALAYA BAY
ZONE 0
Chene, Boeuf, and Black Navigation Channel
Pointe au Fer Reef
Terrebonne Parish Marshes
Four League Bay
GULF OF MEXICO
N
SCALE OF MILES
5 0 5
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA RIVER BACKWATER AREA
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS CORPS OF ENGINEERS
FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

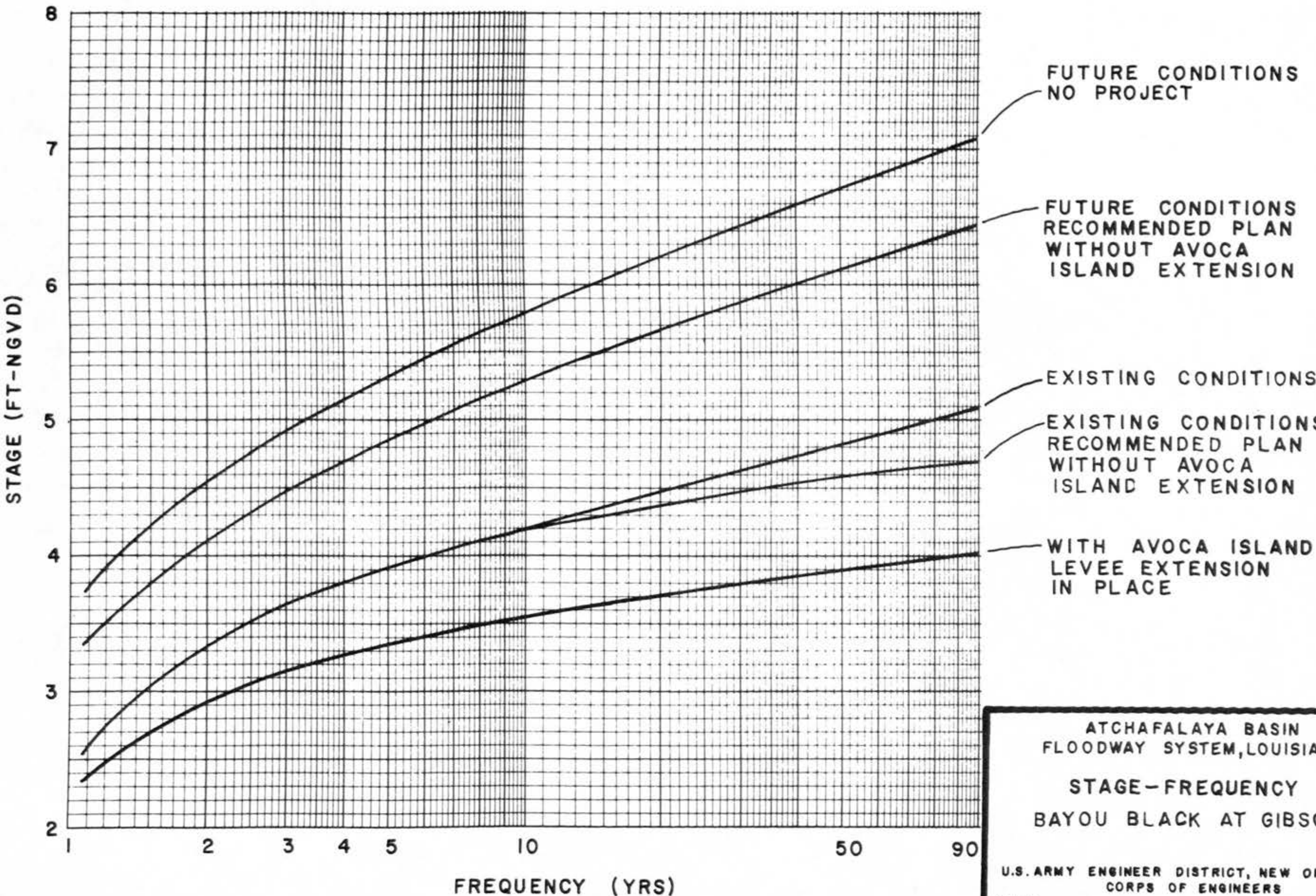
STAGE-FREQUENCY

BAYOU BOEUF AT AMELIA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-49



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

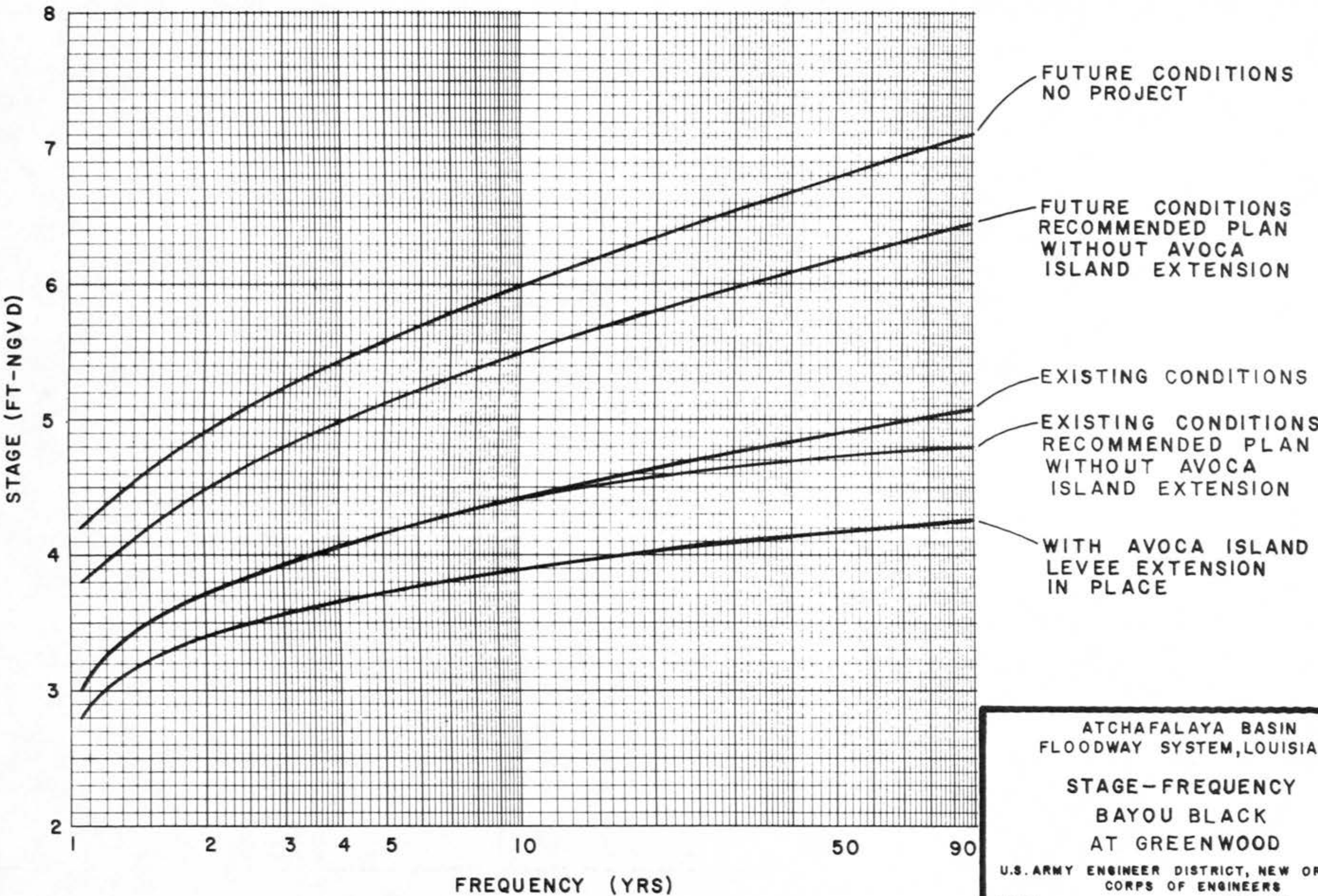
STAGE-FREQUENCY

BAYOU BLACK AT GIBSON

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-50



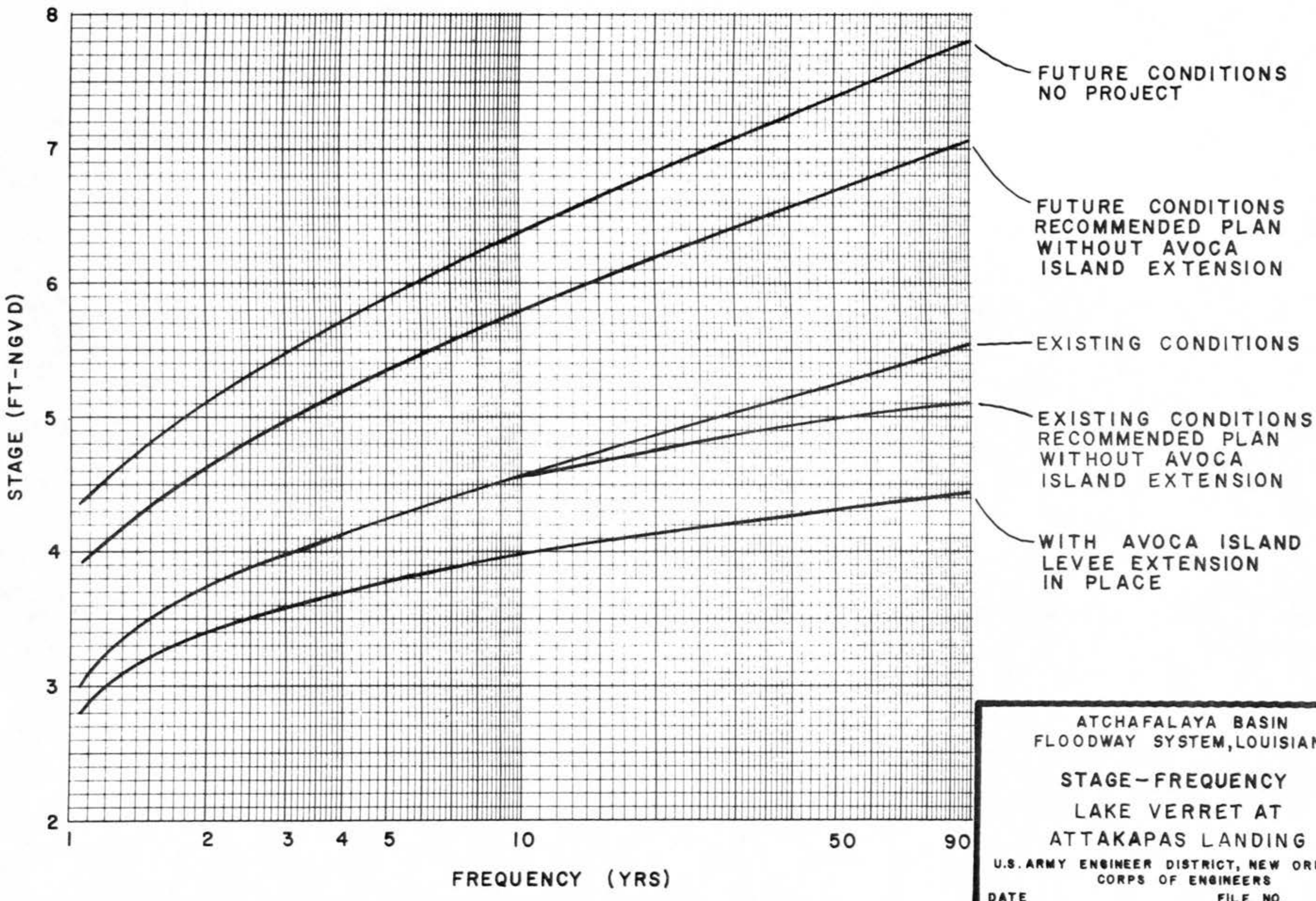
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY
BAYOU BLACK
AT GREENWOOD

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-51



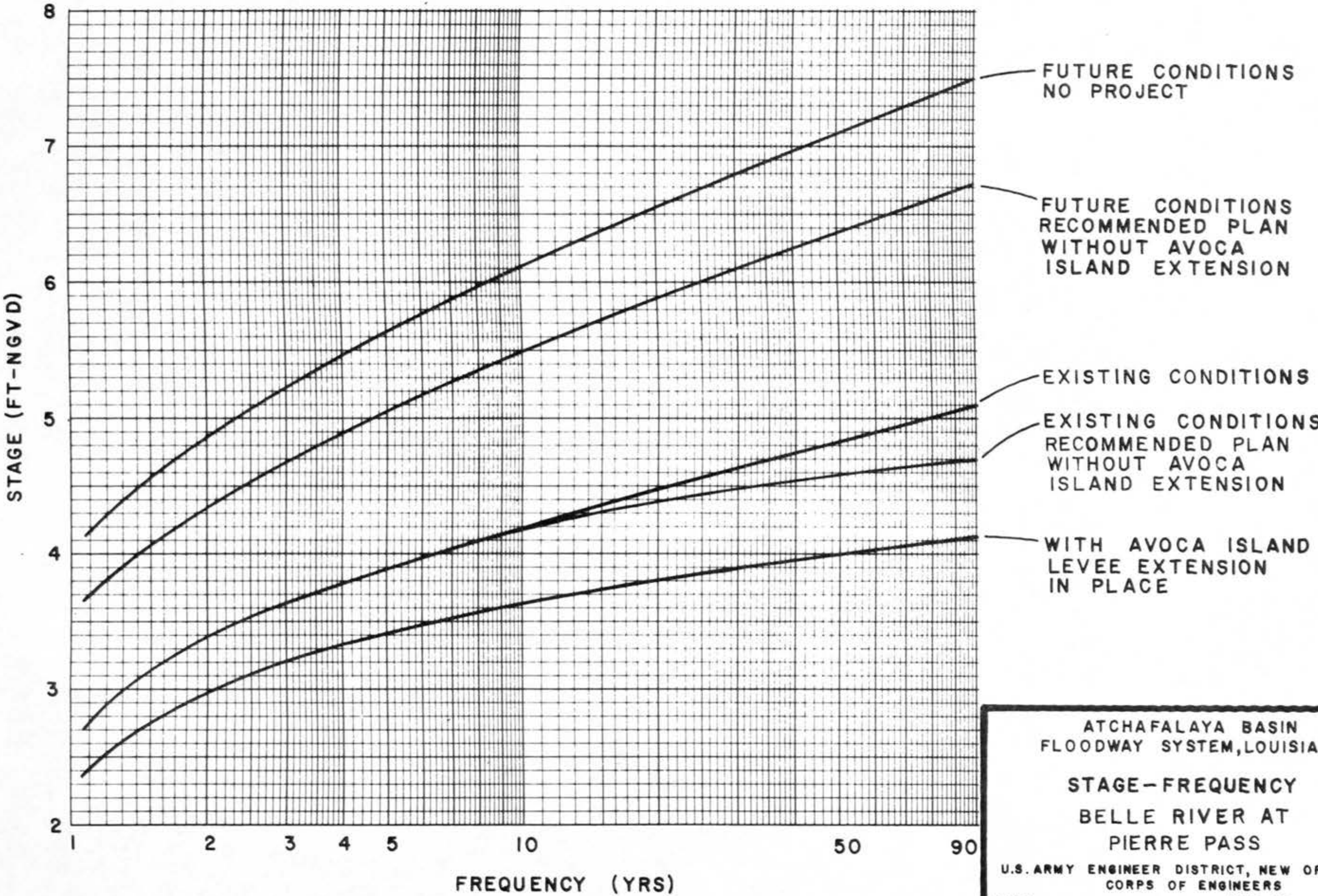
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY
LAKE VERRET AT
ATTAKAPAS LANDING

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-52



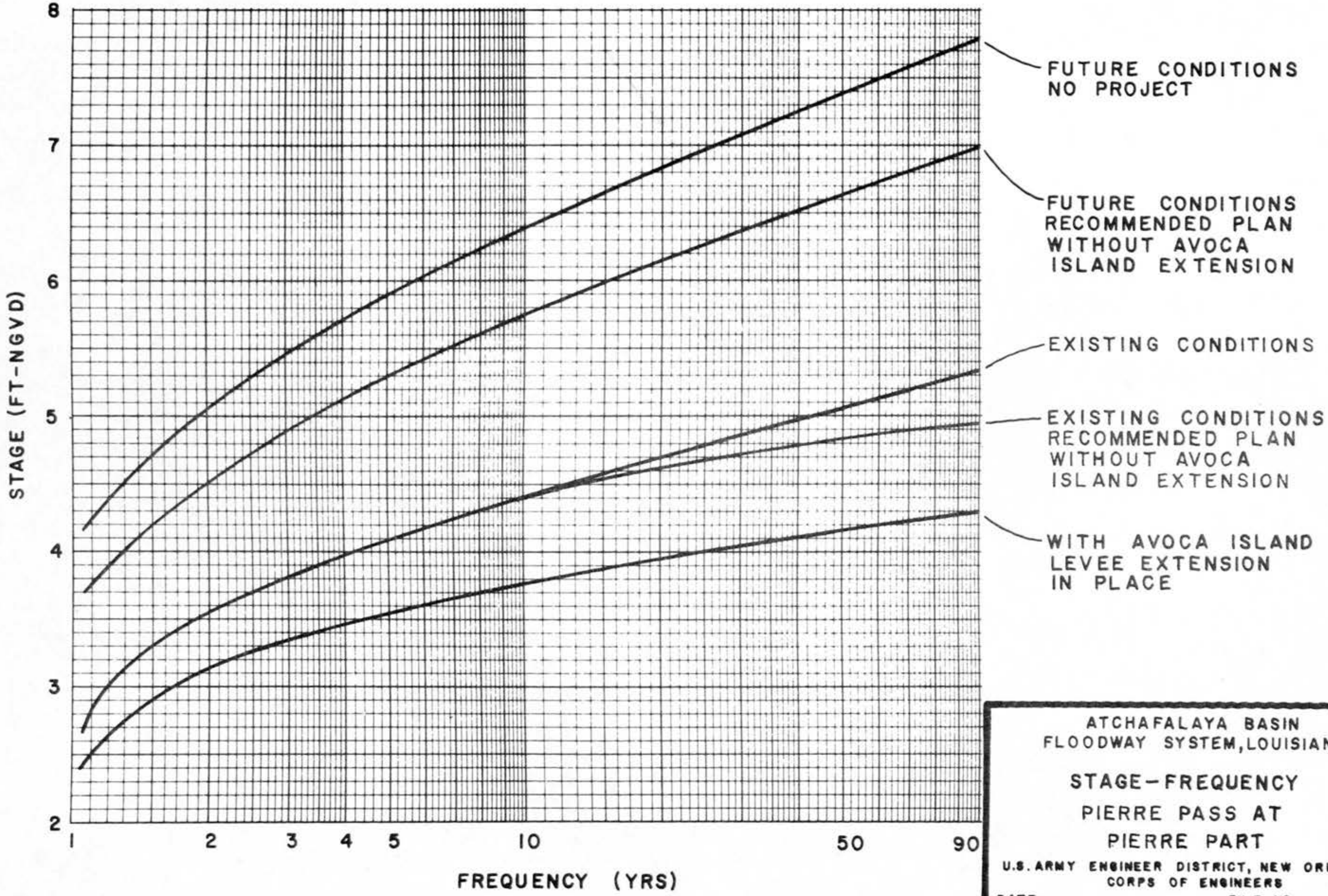
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY
BELLE RIVER AT
PIERRE PASS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-53



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

STAGE-FREQUENCY

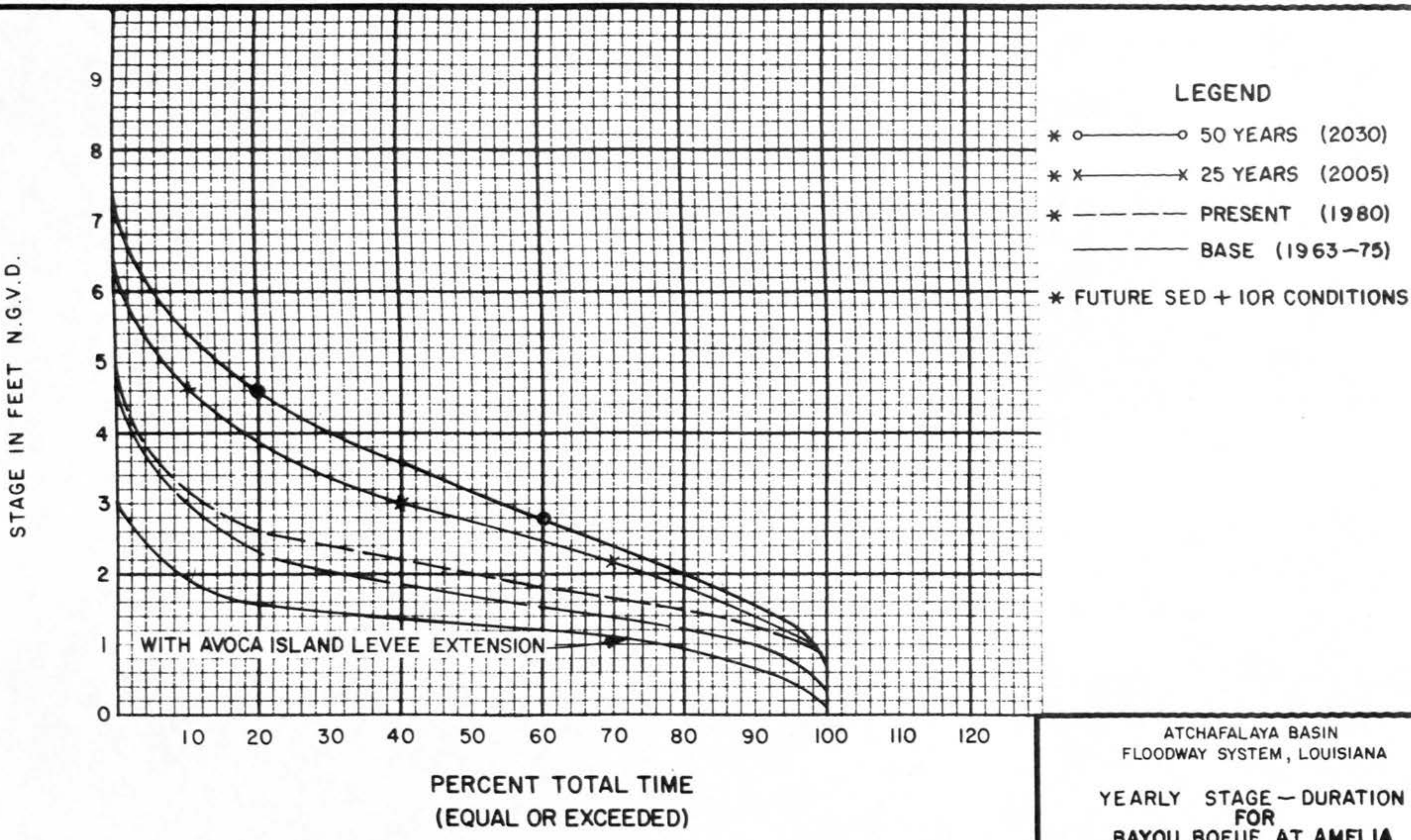
PIERRE PASS AT

PIERRE PART

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-54



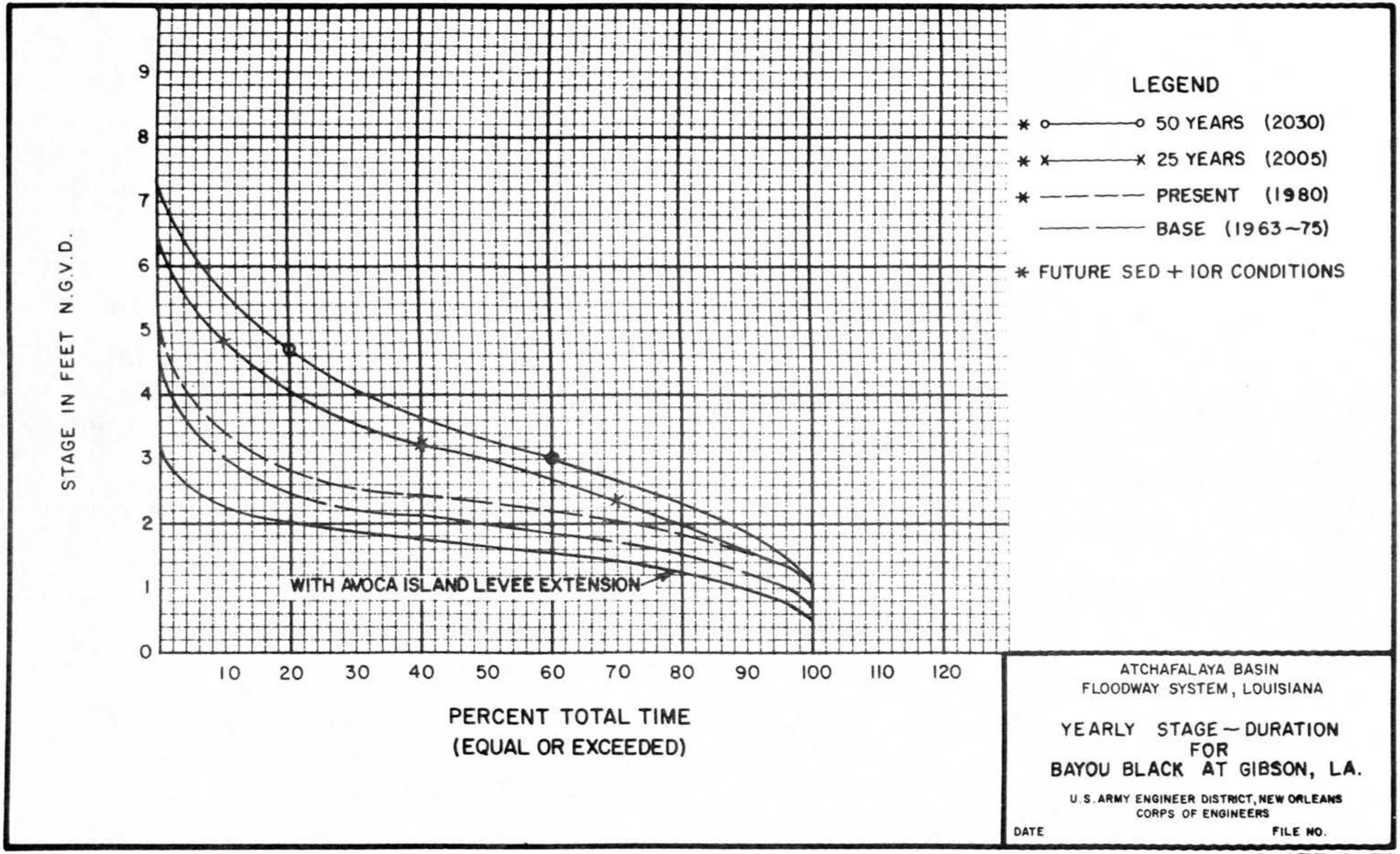
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

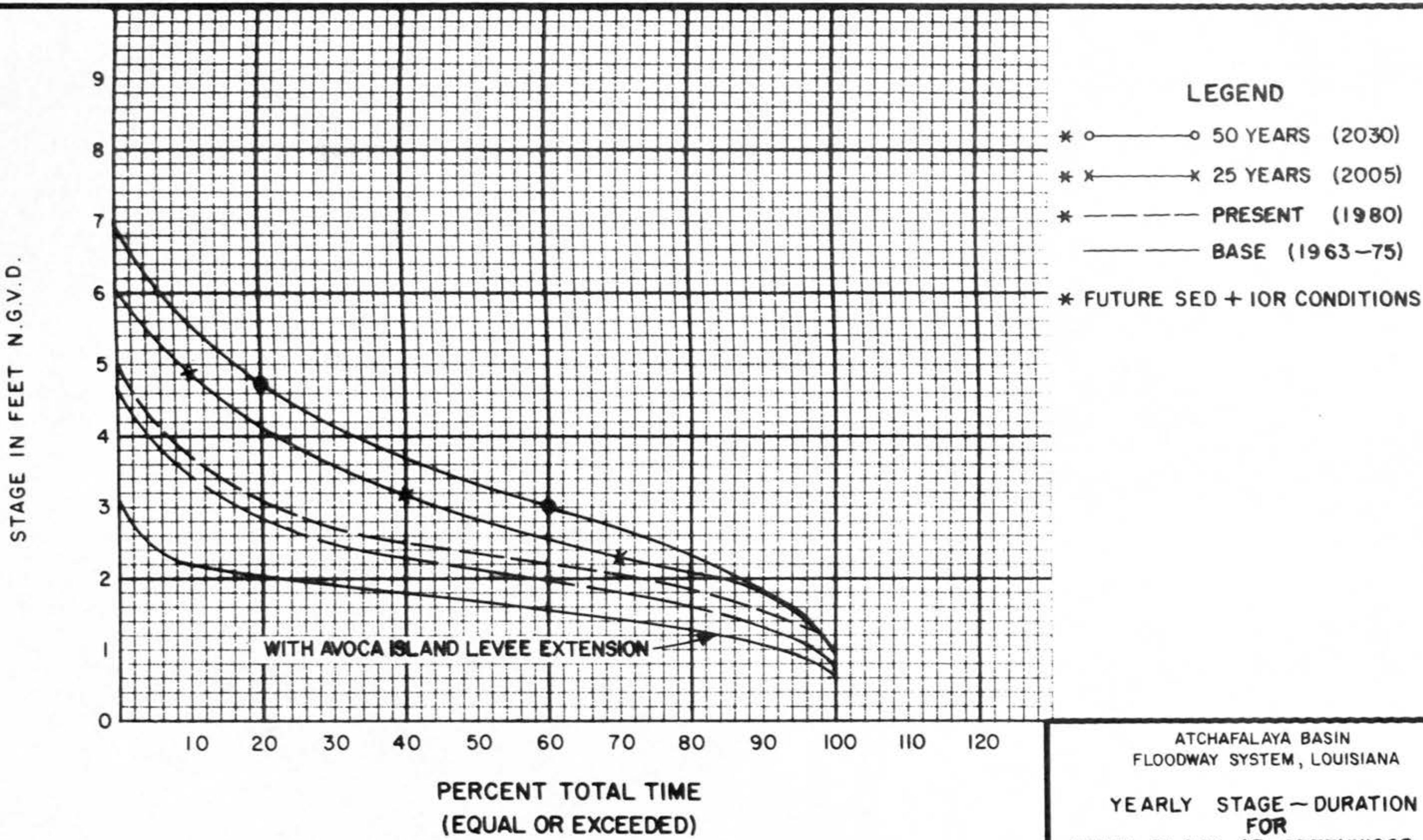
YEARLY STAGE — DURATION
FOR
BAYOU BOEUF AT AMELIA

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-55


LEGEND
* 50 YEARS (2030)
* 25 YEARS (2005)
* PRESENT (1980)
BASE (1963~75)
* FUTURE SED + IOR CONDITIONS
STAGE IN FEET N.G.V.D.
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
WITH AVOCA ISLAND LEVEE EXTENSION
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE — DURATION
FOR
BAYOU BLACK AT GIBSON, LA.
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

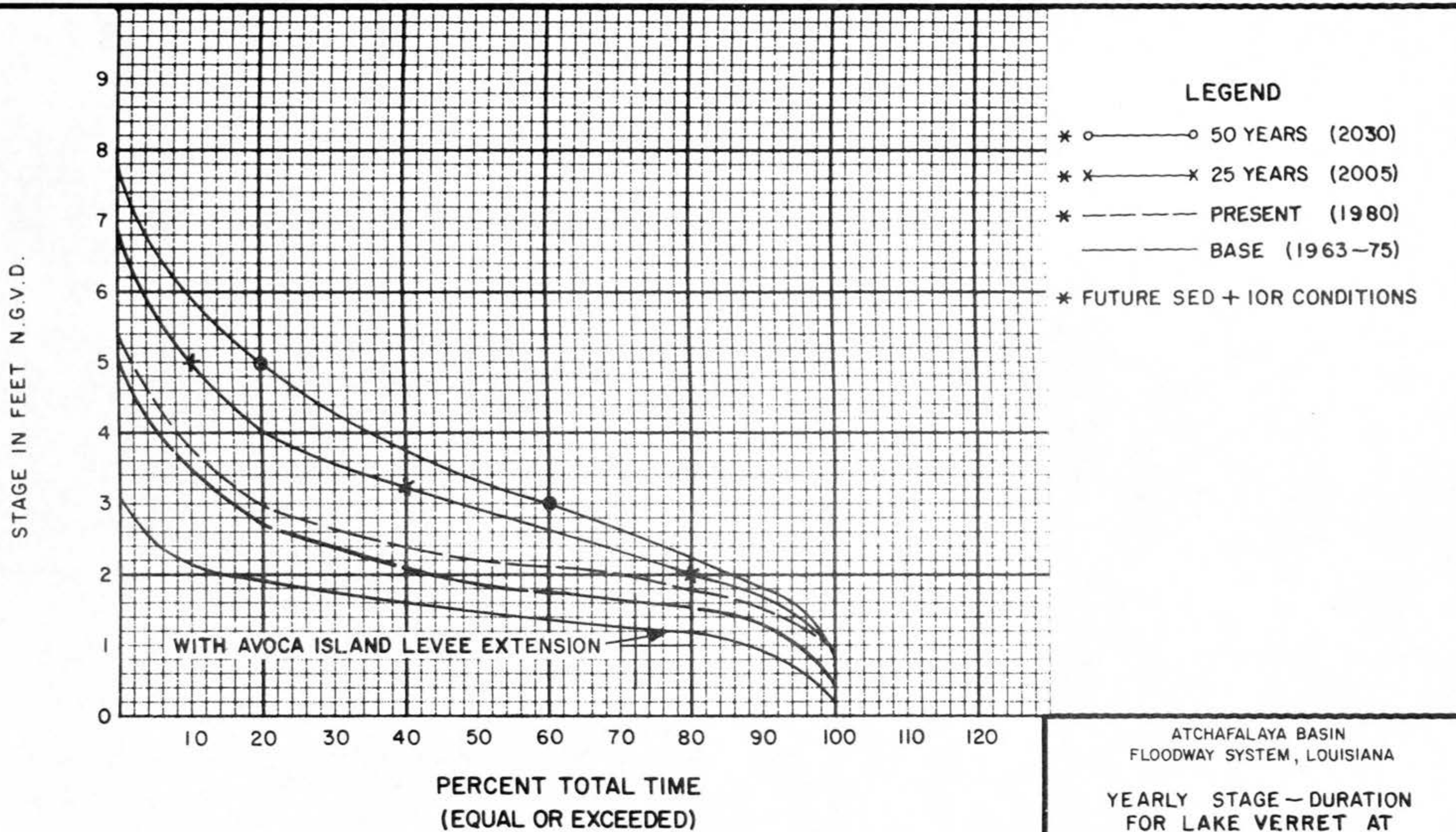


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

YEARLY STAGE — DURATION FOR BAYOU BLACK AT GREENWOOD, LA.

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.



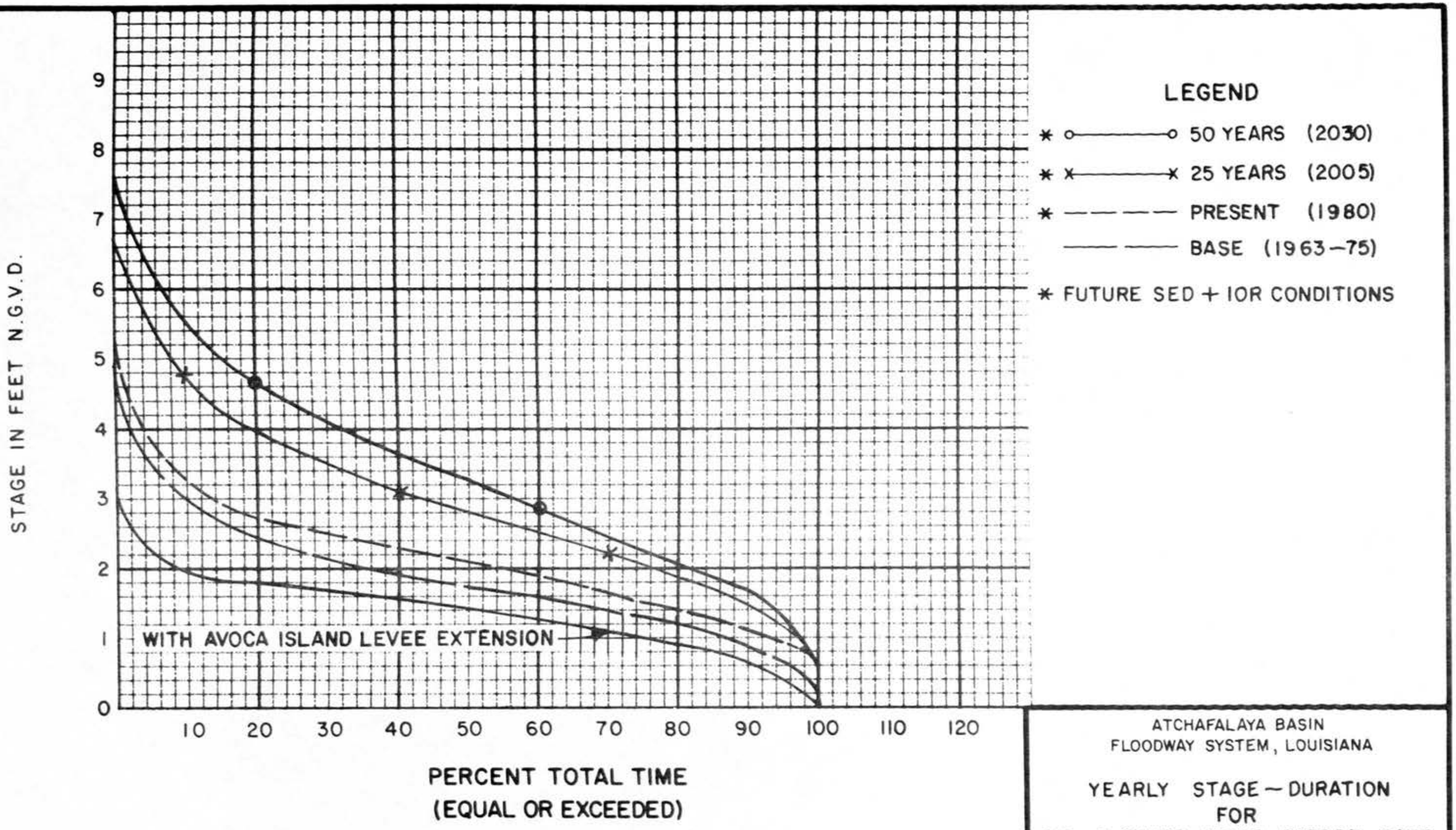
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

YEARLY STAGE — DURATION FOR LAKE VERRET AT ATTAKAPAS LANDING

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-58



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

YEARLY STAGE — DURATION
FOR
BELLE RIVER NEAR PIERRE PASS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-59

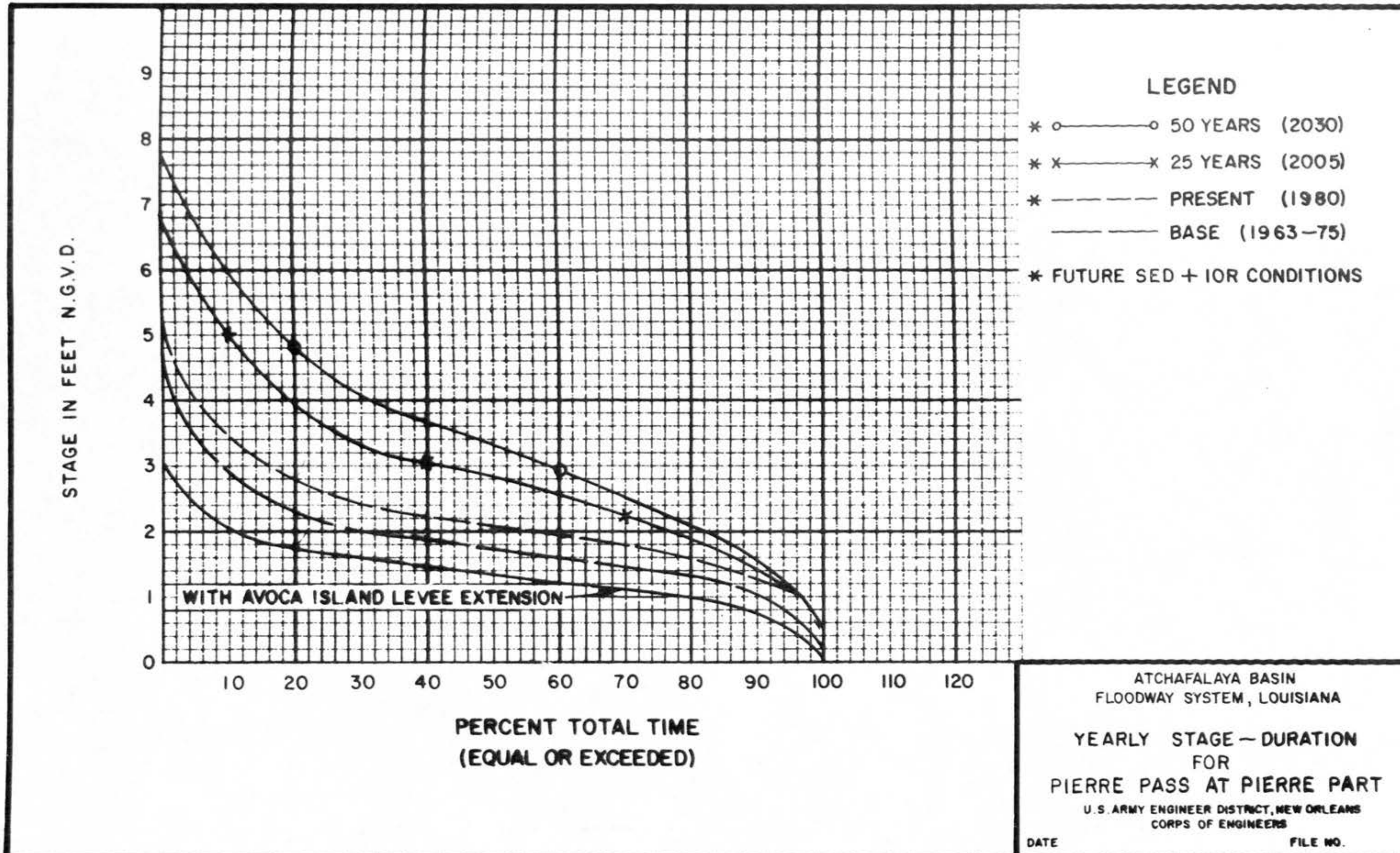
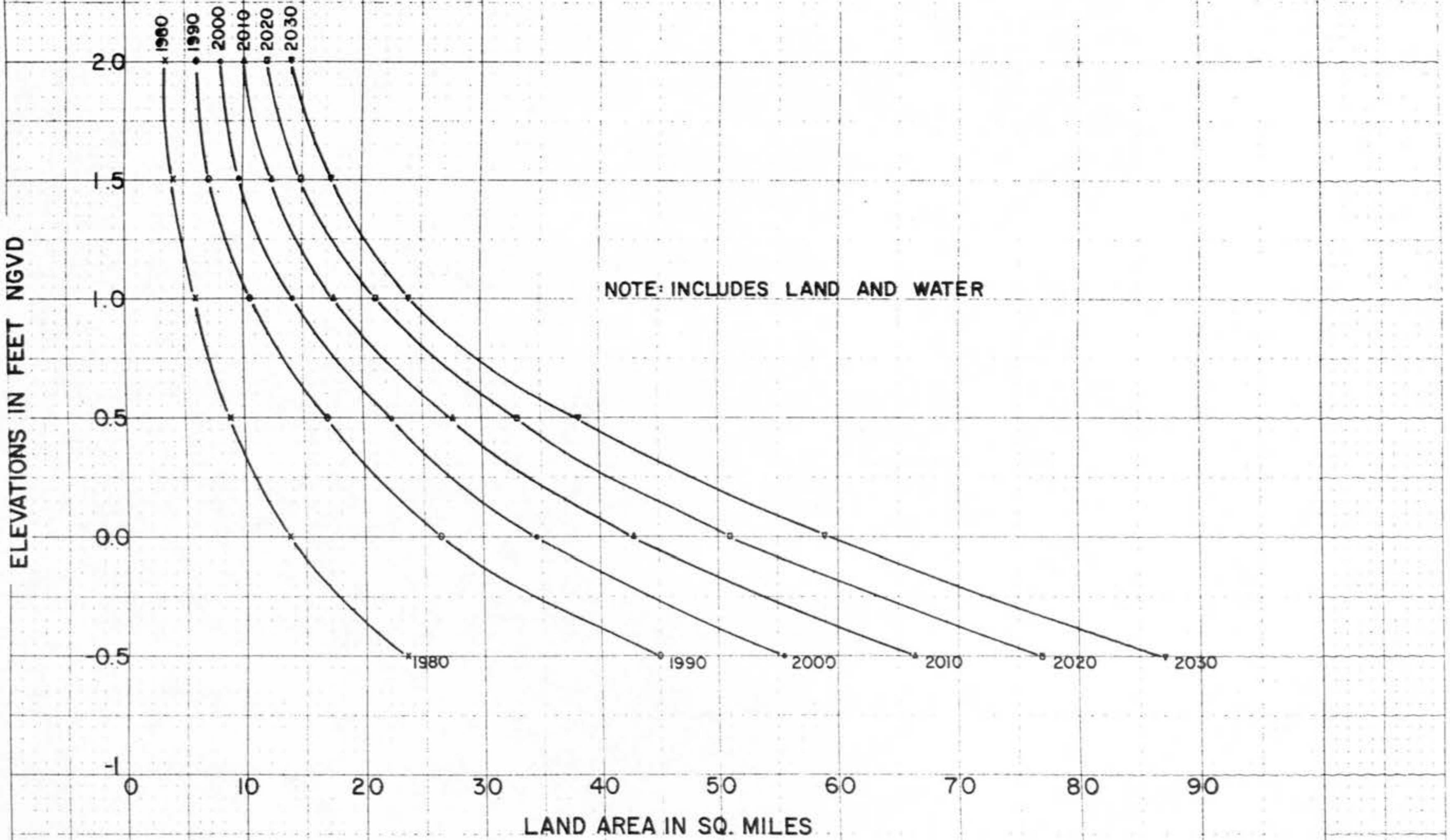

LEGEND
50 YEARS (2030)
25 YEARS (2005)
PRESENT (1980)
BASE (1963-75)
* FUTURE SED + IOR CONDITIONS
STAGE IN FEET N.G.V.D.
PERCENT TOTAL TIME
(EQUAL OR EXCEEDED)
WITH AVOCA ISLAND LEVEE EXTENSION
0
1
2
3
4
5
6
7
8
9
10
20
30
40
50
60
70
80
90
100
110
120
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
YEARLY STAGE — DURATION
FOR
PIERRE PASS AT PIERRE PART
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-60



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY
DELTA AREA VS ELEVATION

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-61

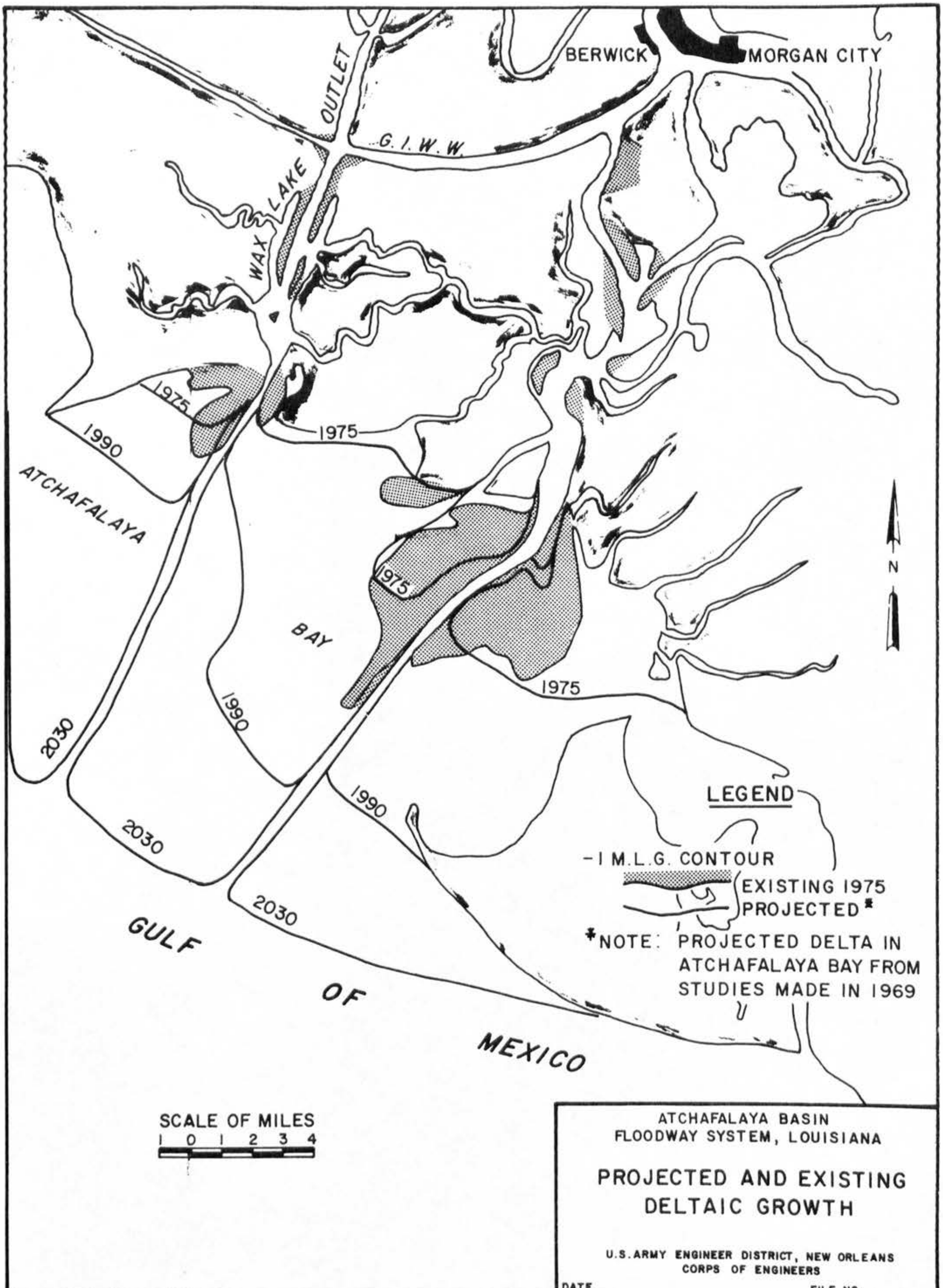
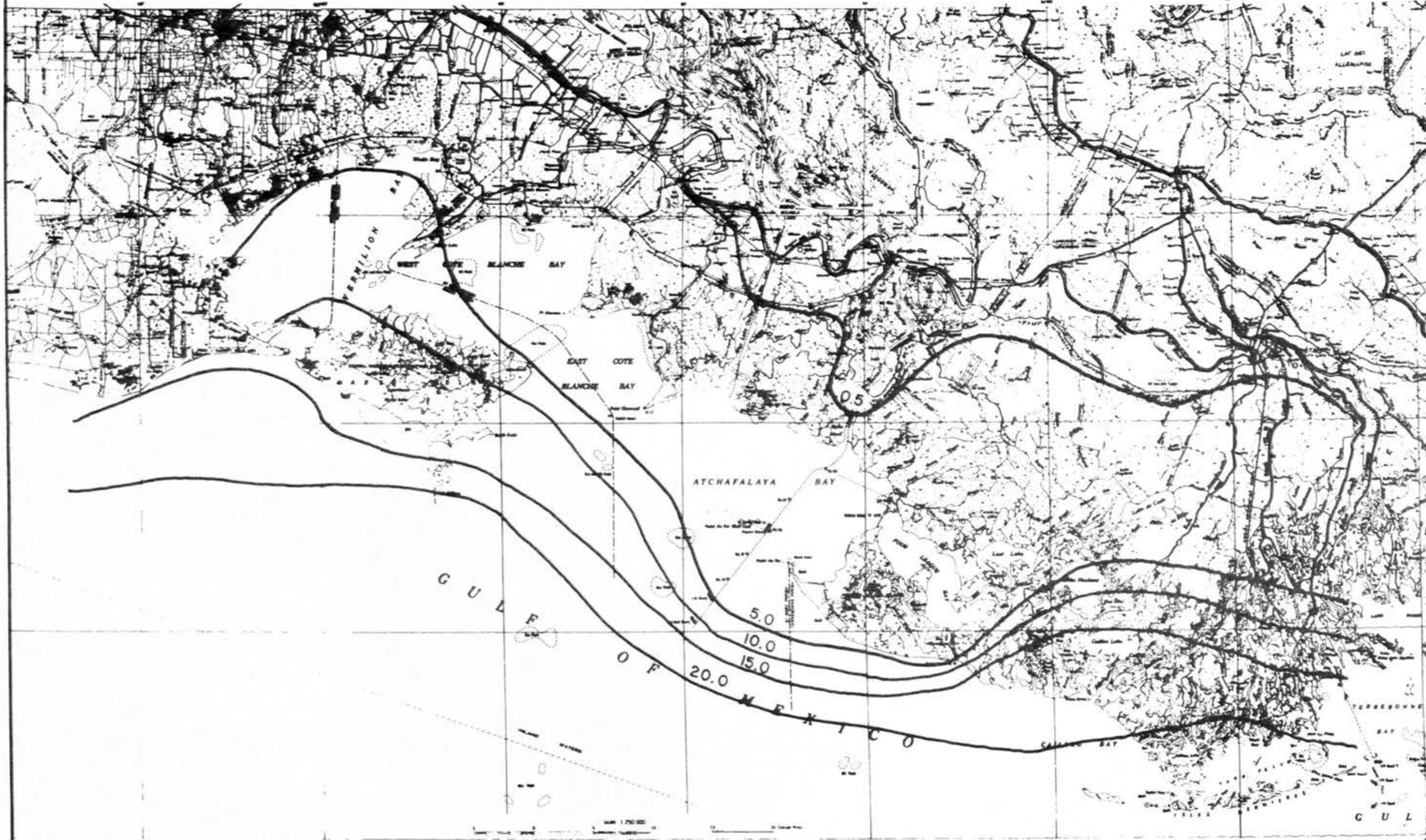

BERWICK
MORGAN CITY
OUTLET
G.I.W.W.
WAX LAKE
1975
1975
1990
ATCHAFALAYA
1975
BAY
1975
1990
2030
2030
1990
2030
GULF OF MEXICO
N
LEGEND
-1 M.L.G. CONTOUR
EXISTING 1975
PROJECTED*
*NOTE: PROJECTED DELTA IN ATCHAFALAYA BAY FROM STUDIES MADE IN 1969
SCALE OF MILES
1 0 1 2 3 4
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
PROJECTED AND EXISTING
DELTAIC GROWTH
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-62



ATCHAFALAYA BASIN

FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES

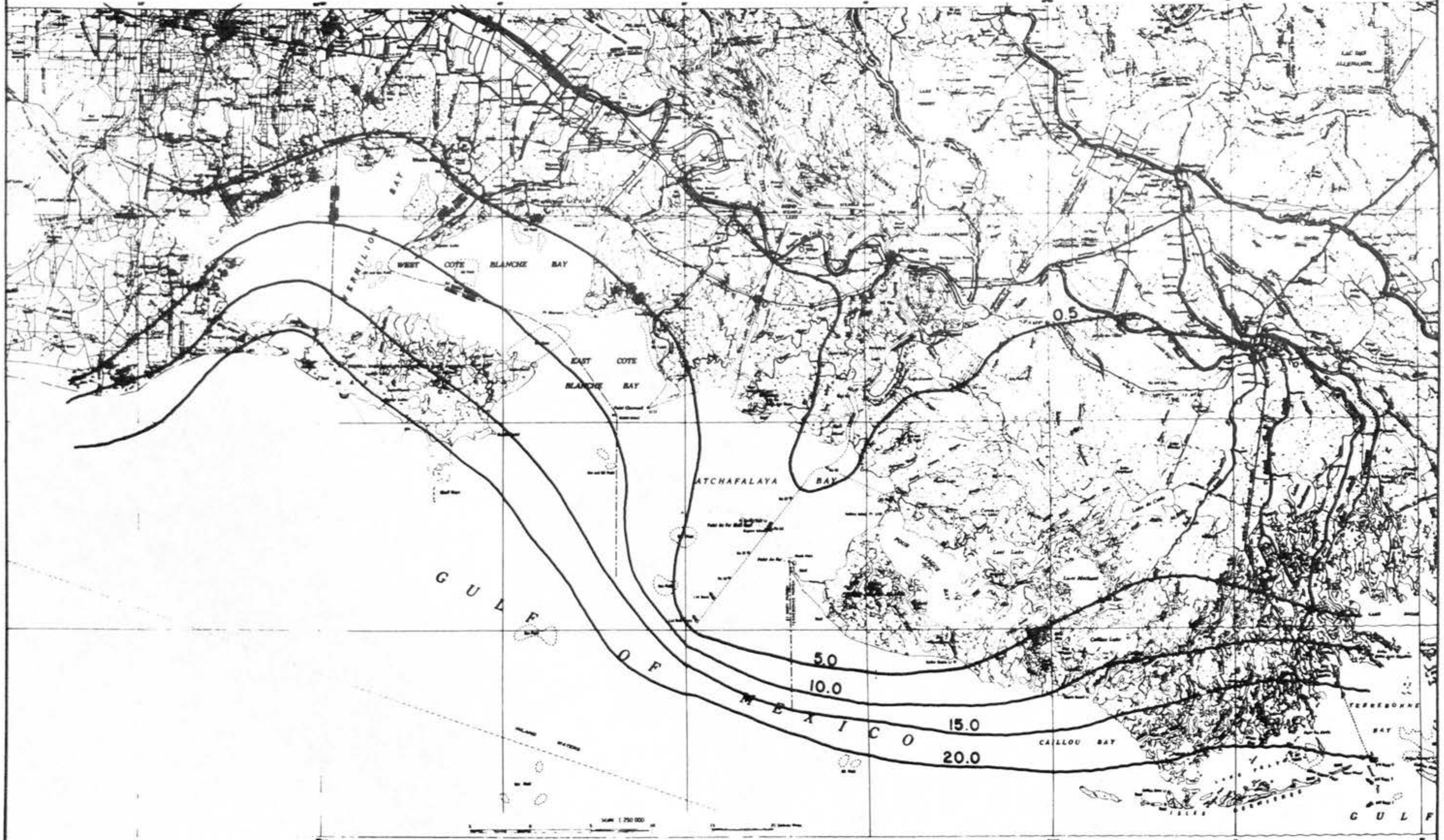
PRESENT 90,000 CFS 70/30

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-63

PLATE C-63



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

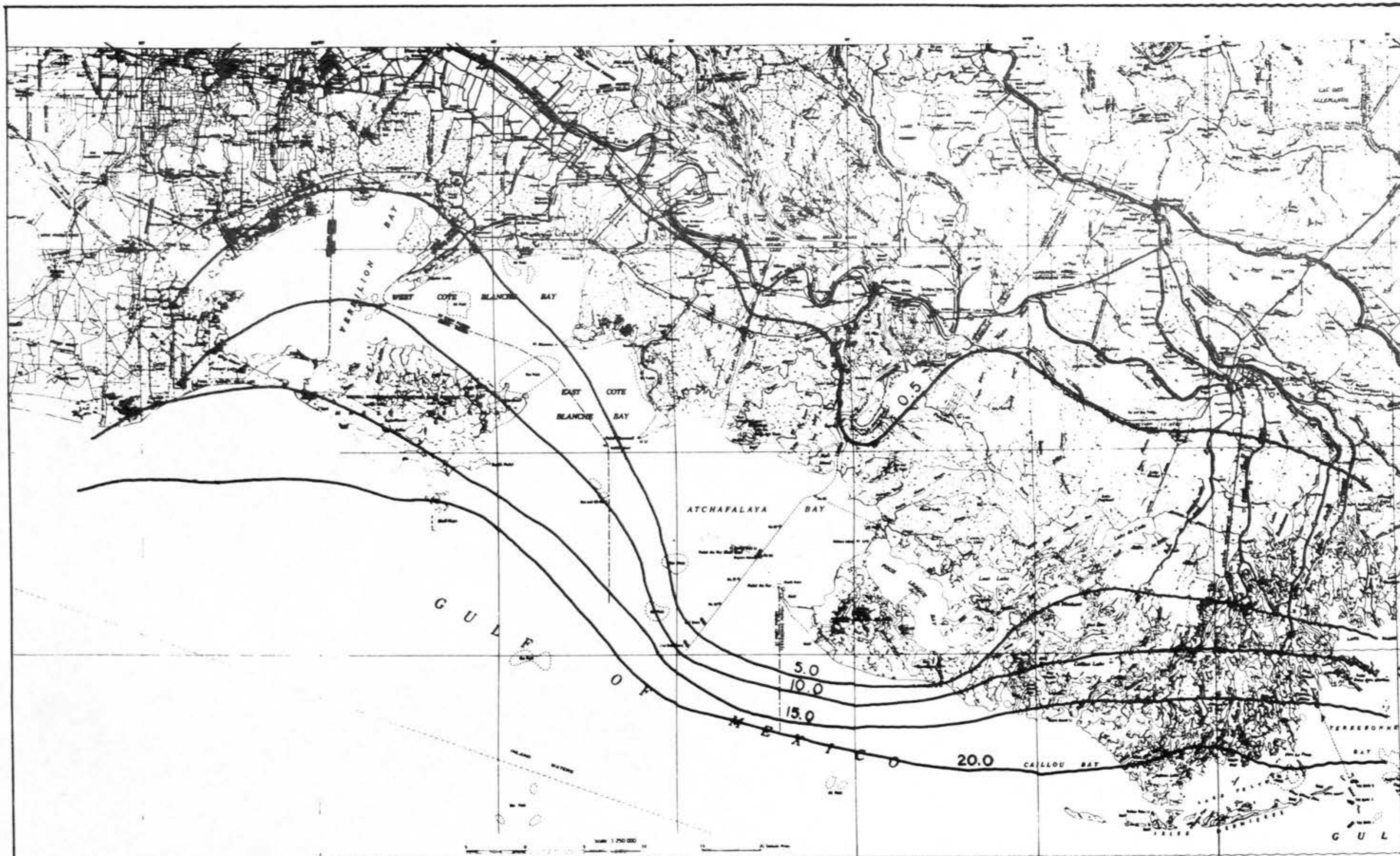
ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-64

PLATE C-64

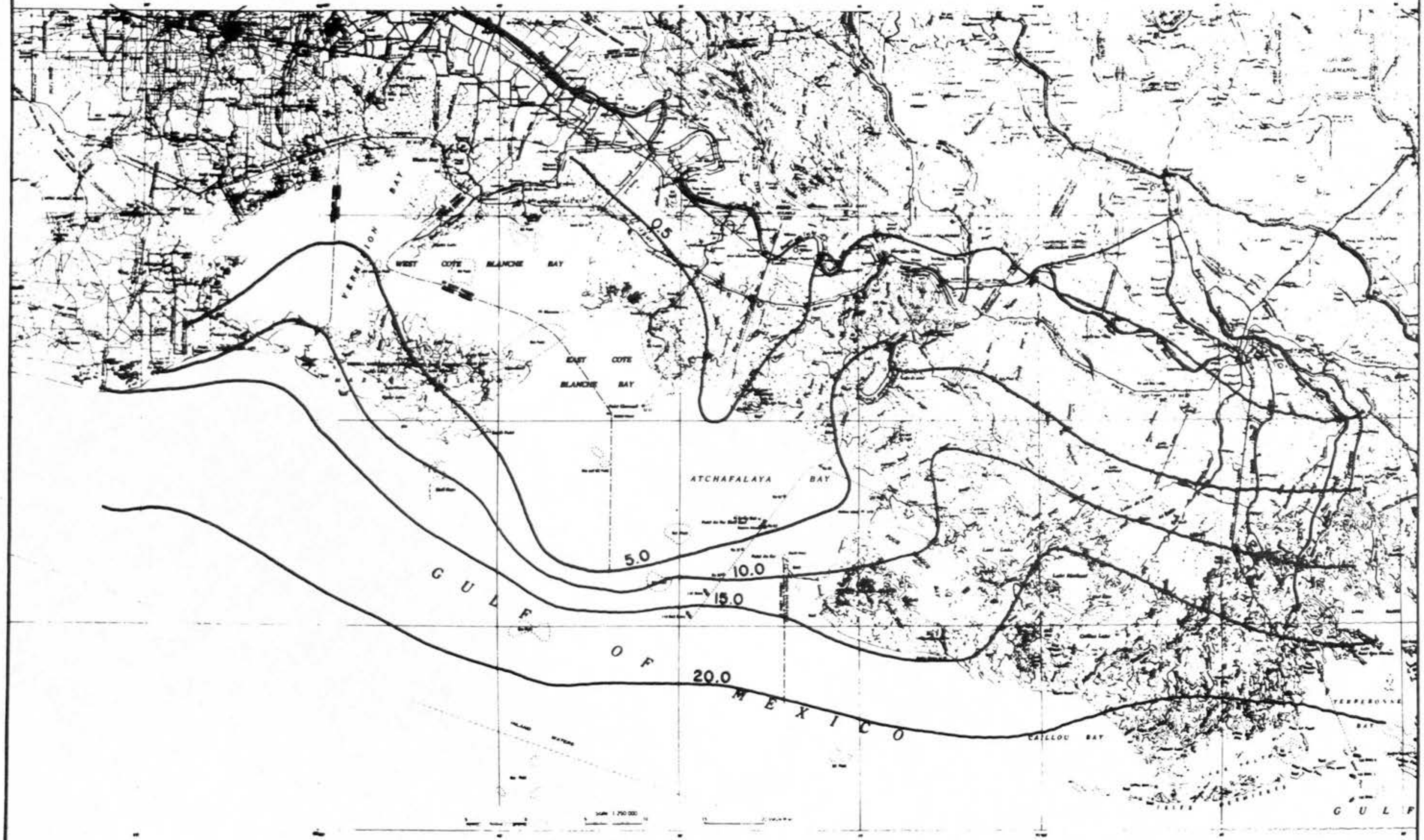


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 80/20

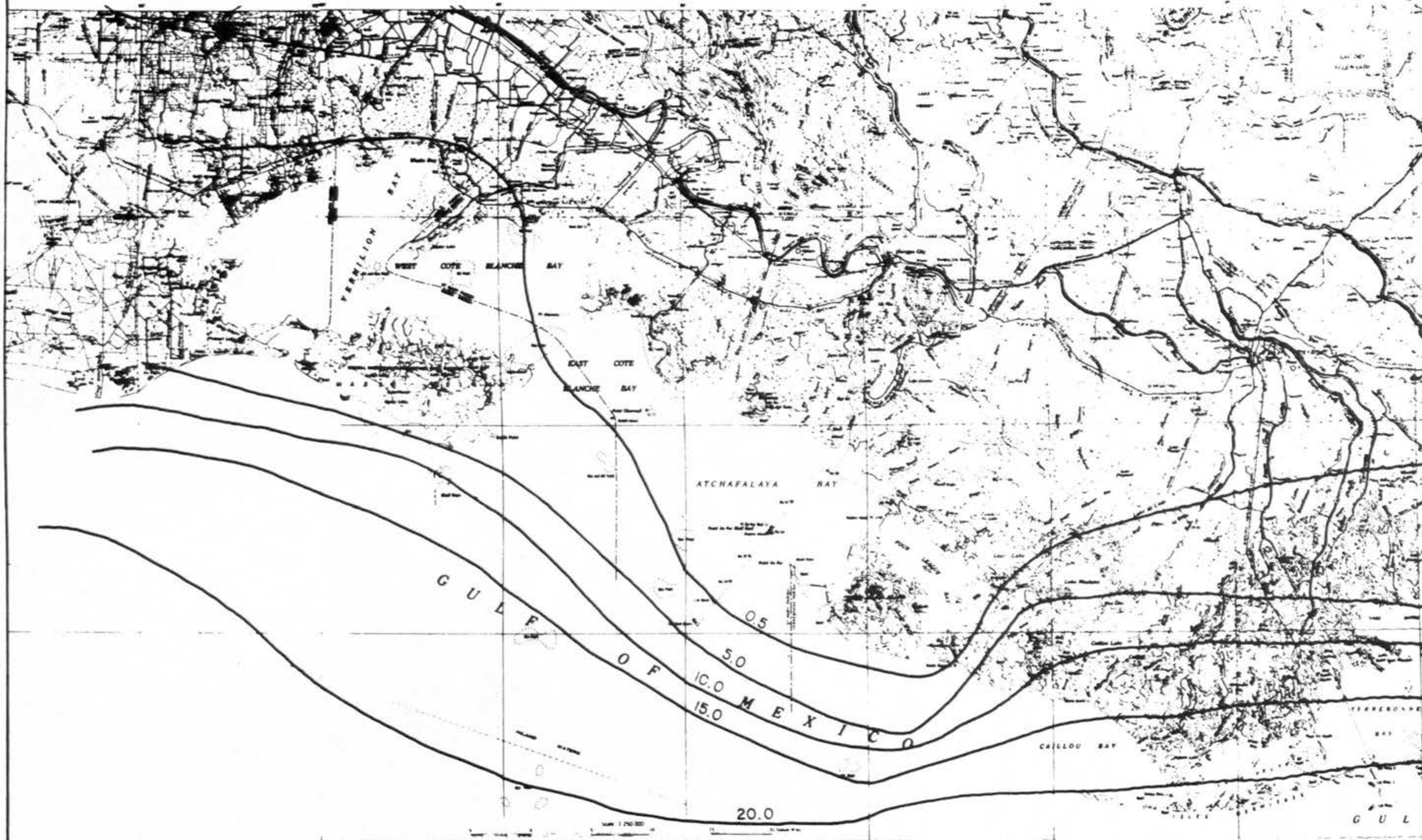
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BAY ISOHALINES
PRESENT 90,000 CFS 0/100
U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
FILE NO.

PLATE C-66



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

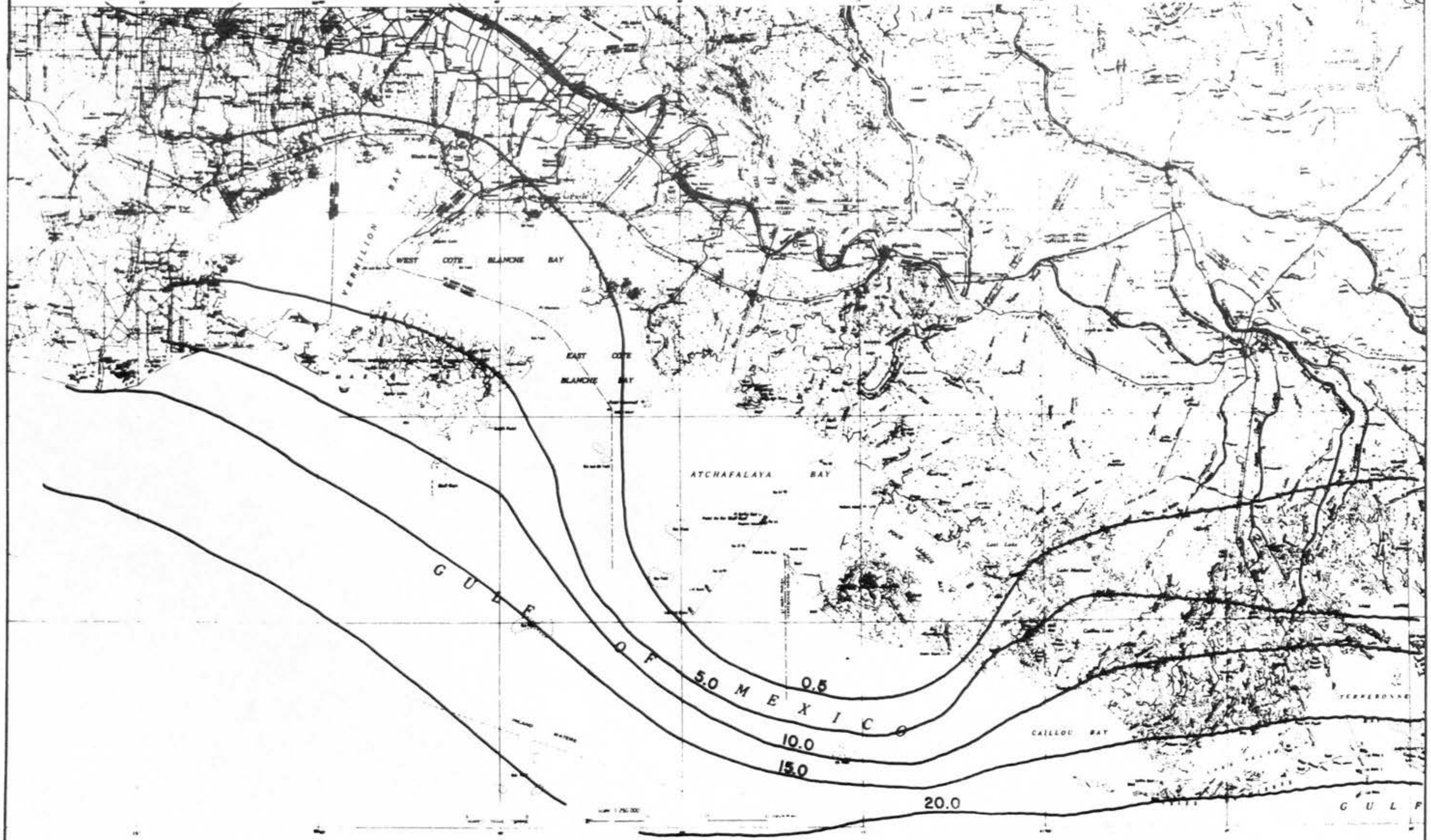
ATCHAFALAYA BAY ISOHALINES

PRESENT 320,000 CFS 70/30

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE-C-67

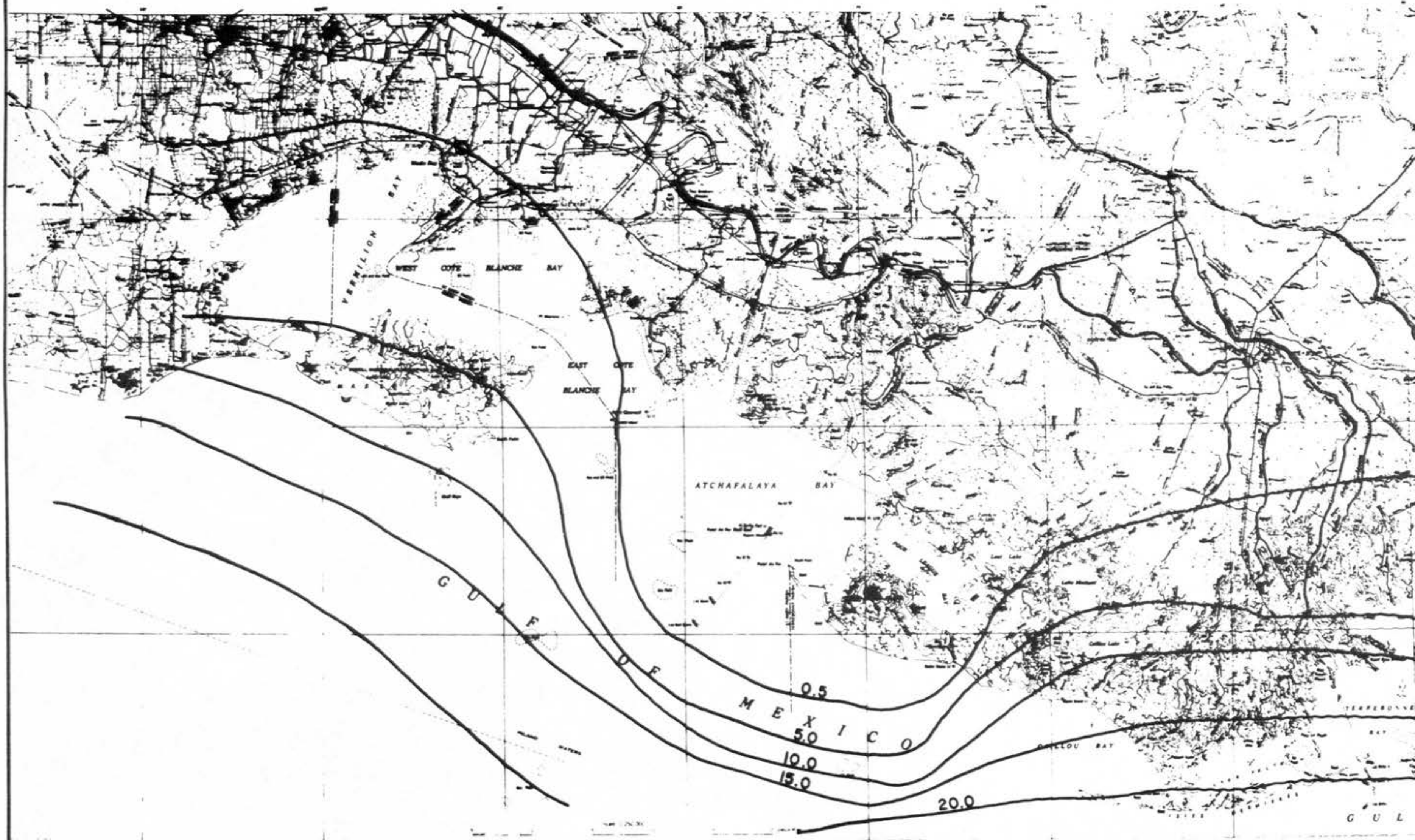


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

PLATE C-68



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

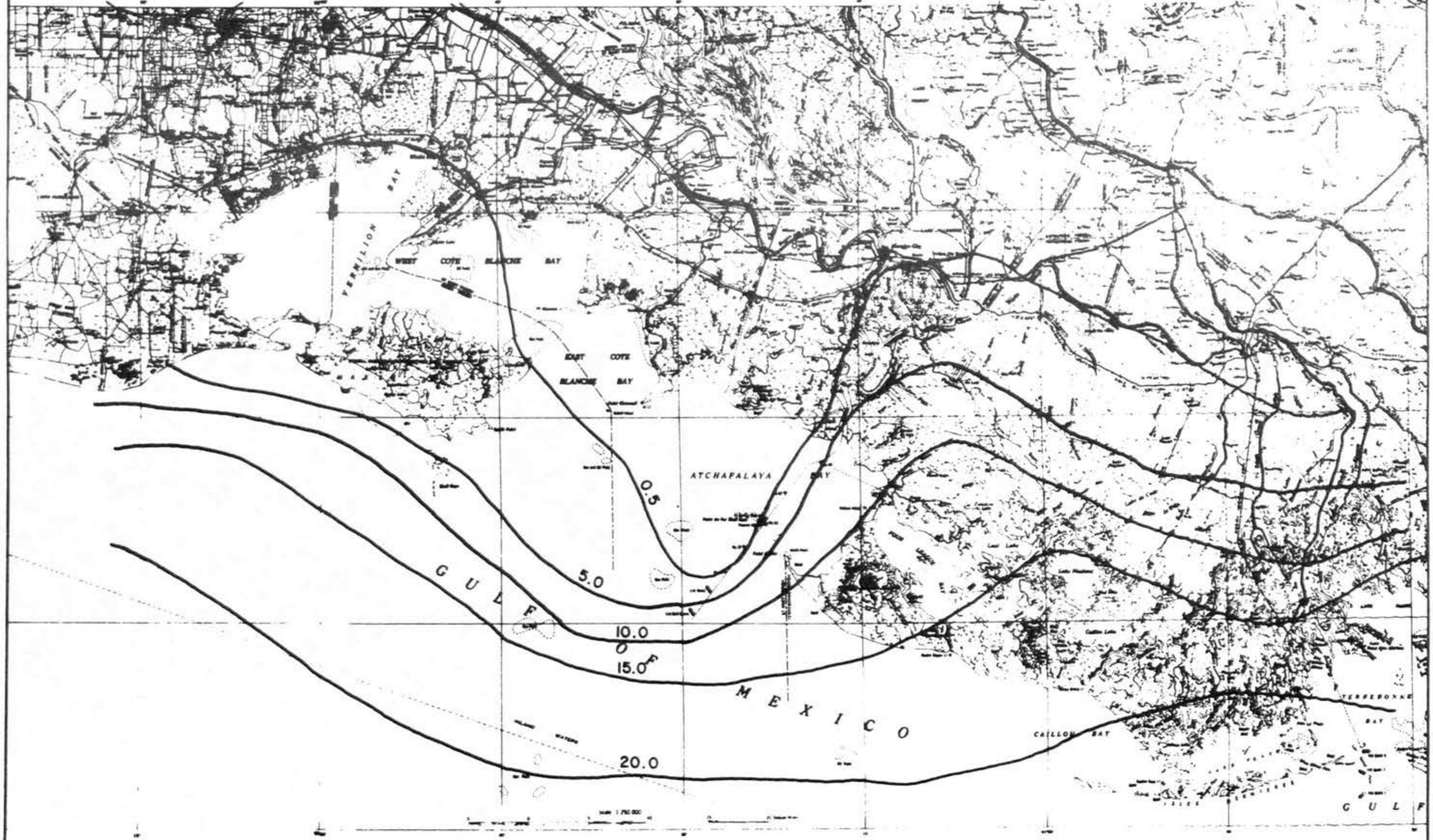
ATCHAFALAYA BAY ISOHALINES

PRESENT 320,000 CFS 80/20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-69



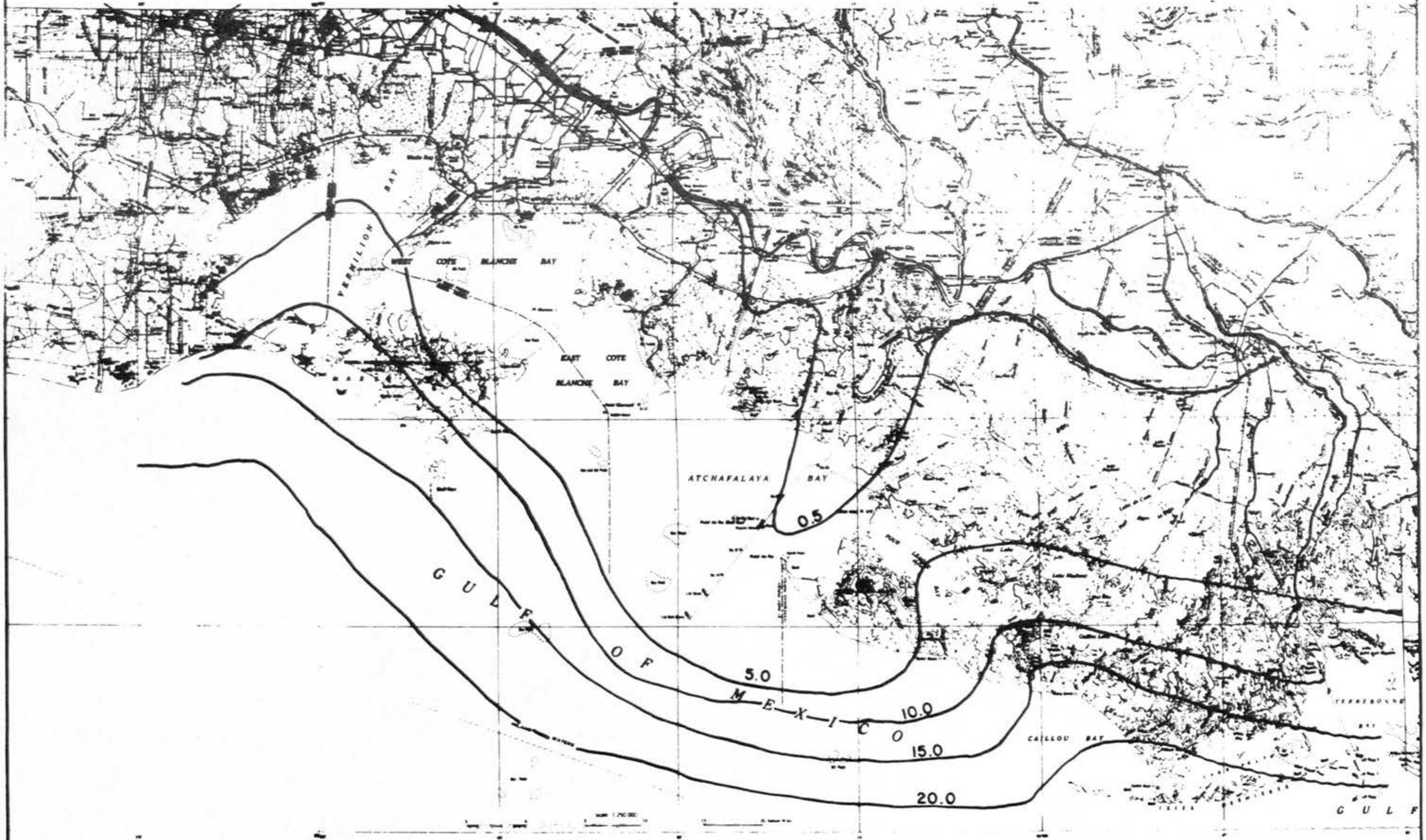
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
PRESENT 320,000 CFS 0/100

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-70



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 70/30

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-71

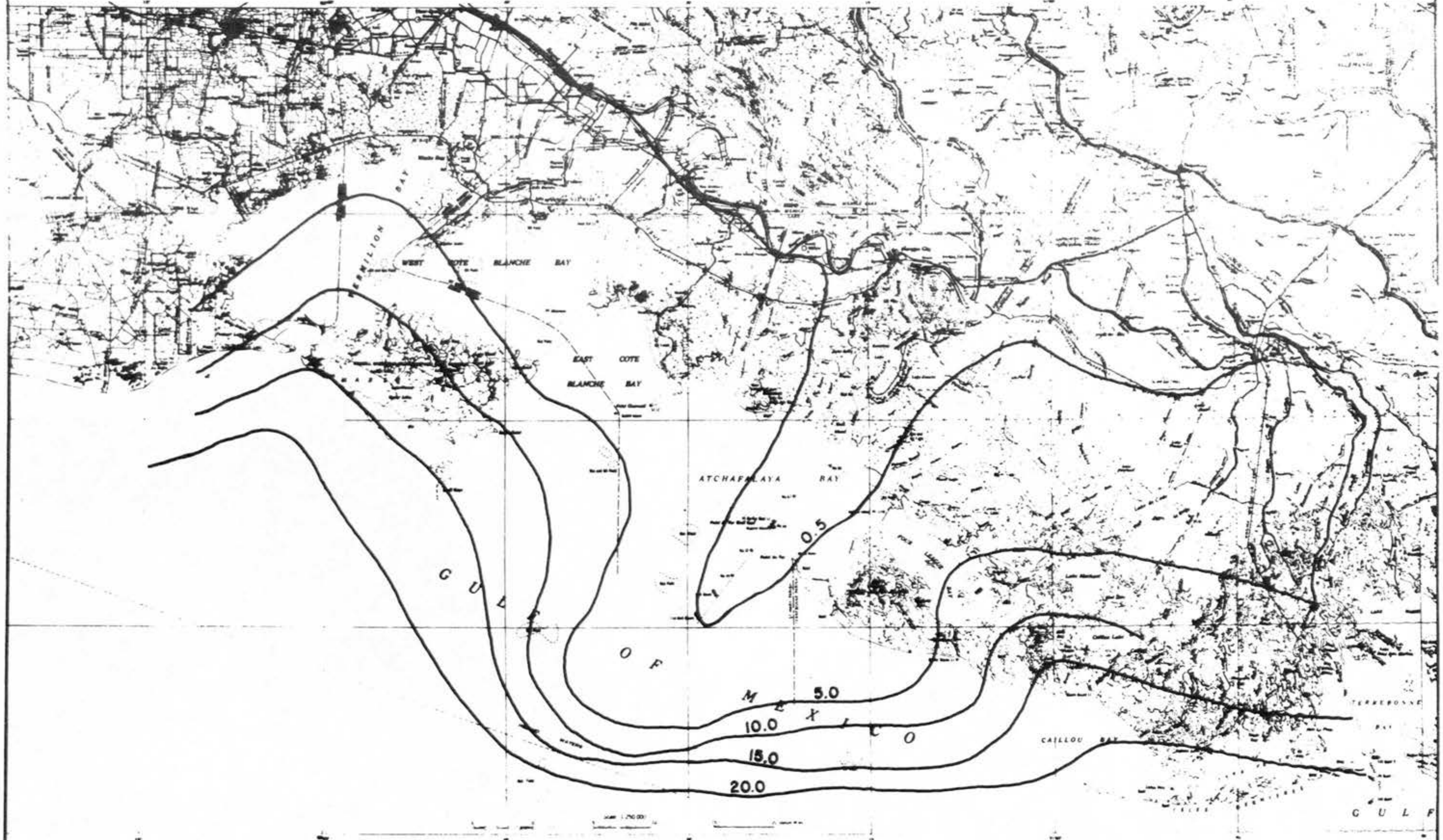


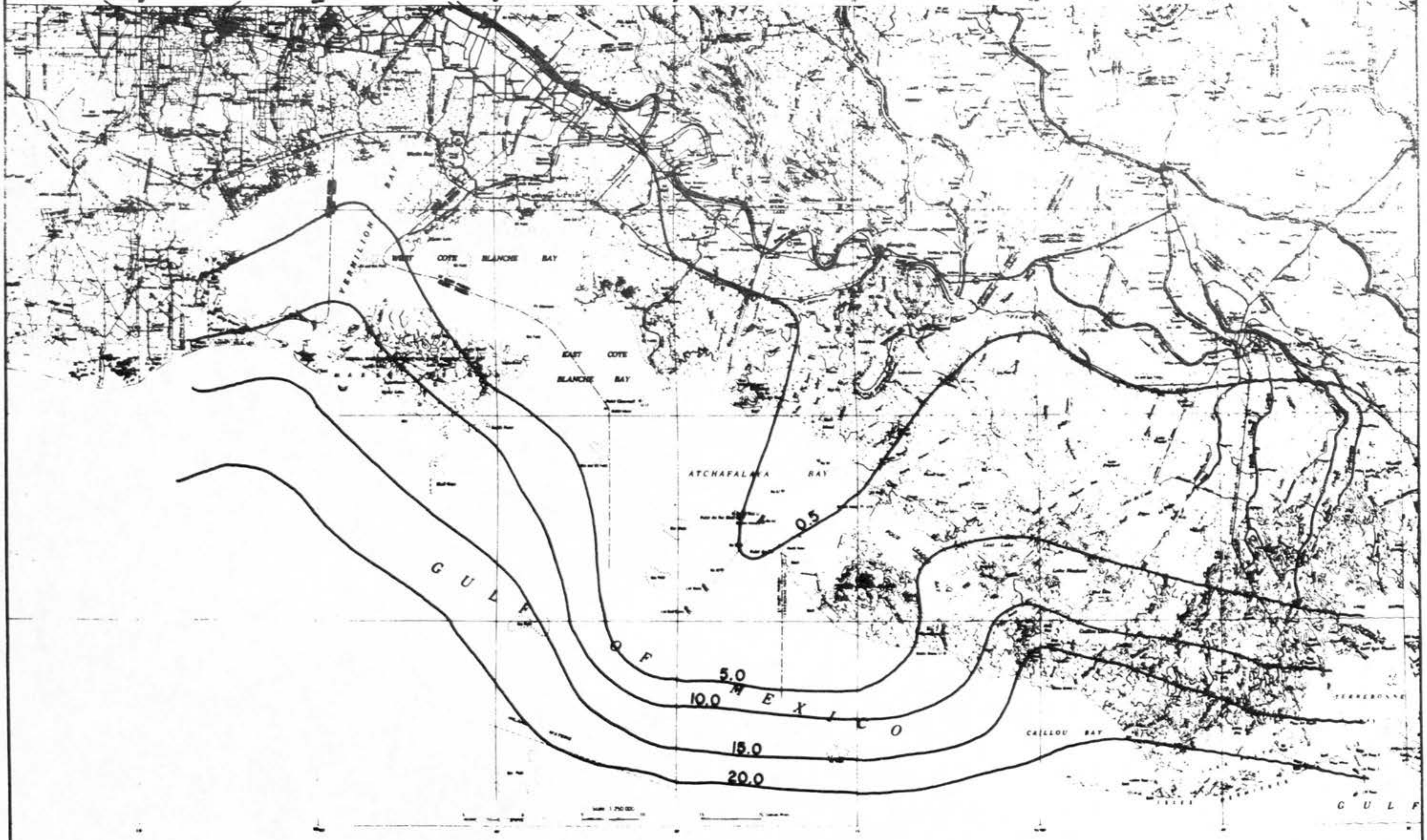
PLATE C-72

ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.



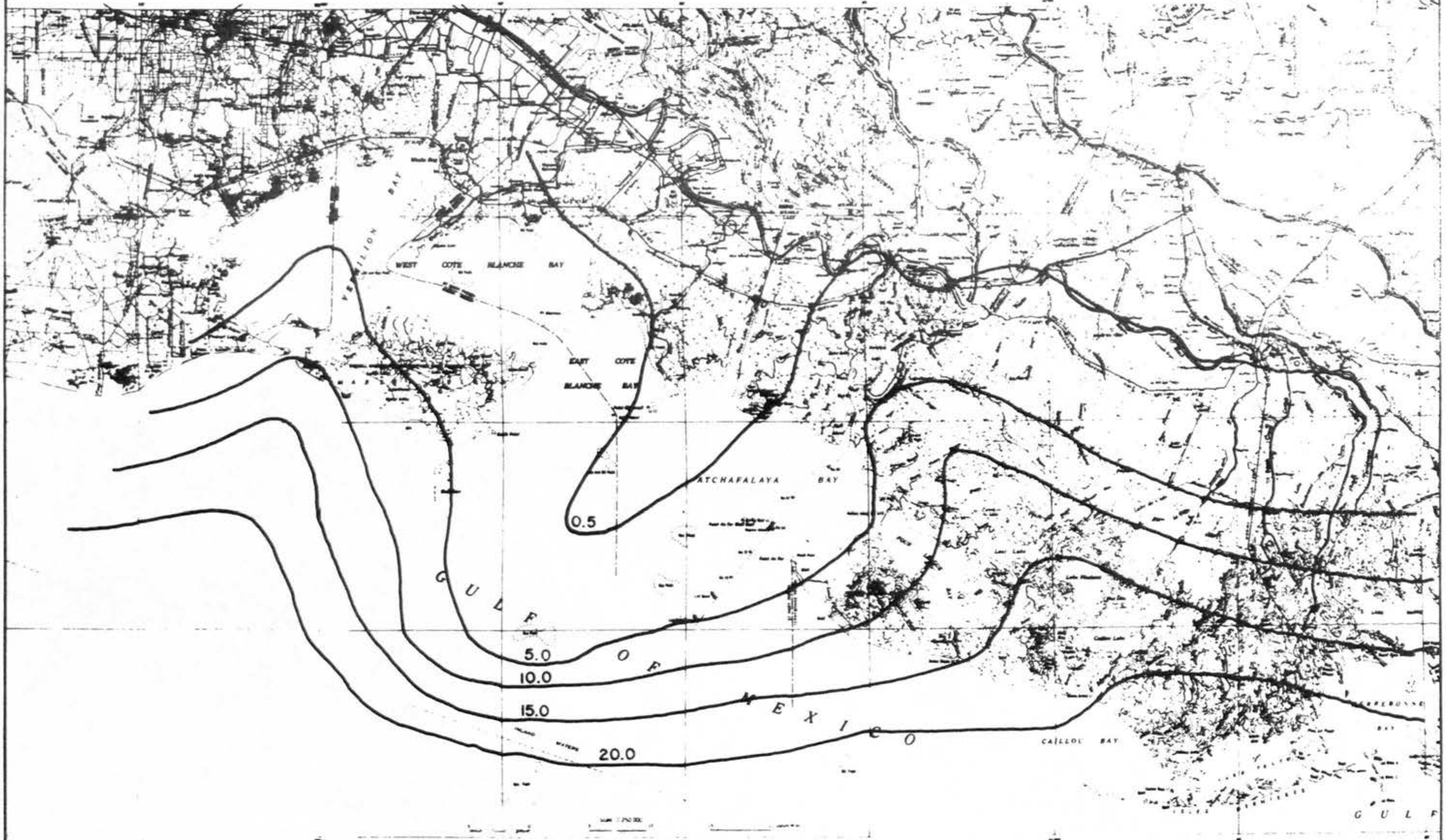
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 90,000 CFS 80/20

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-73



ATCHAFALAYA BASIN

FLOODWAY SYSTEM, LOUISIANA

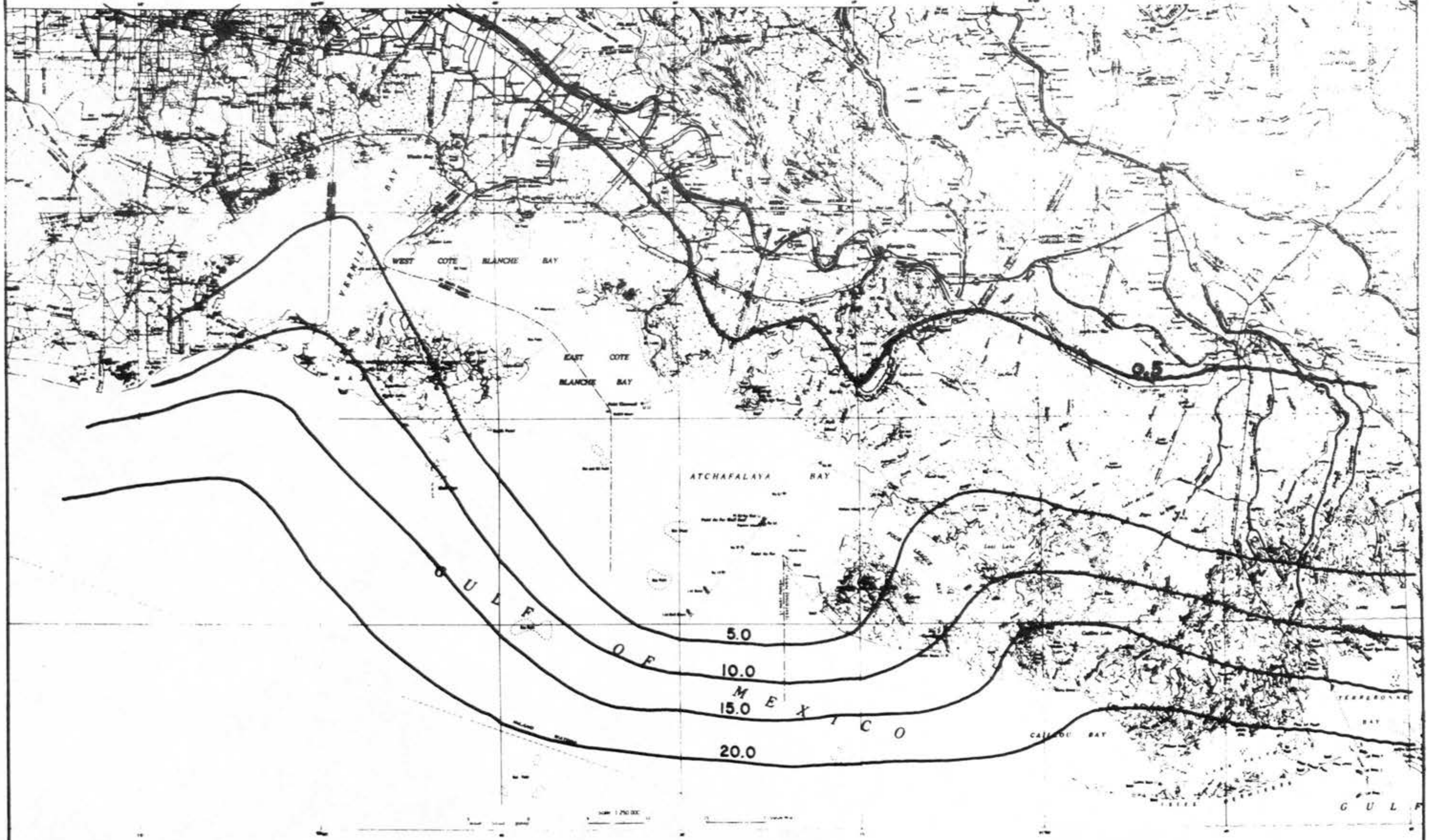
ATCHAFALAYA BAY ISOHALINES

FUTURE 90,000 CFS 0/100

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-74



ATCHAFALAYA BASIN

FLOODWAY SYSTEM, LOUISIANA

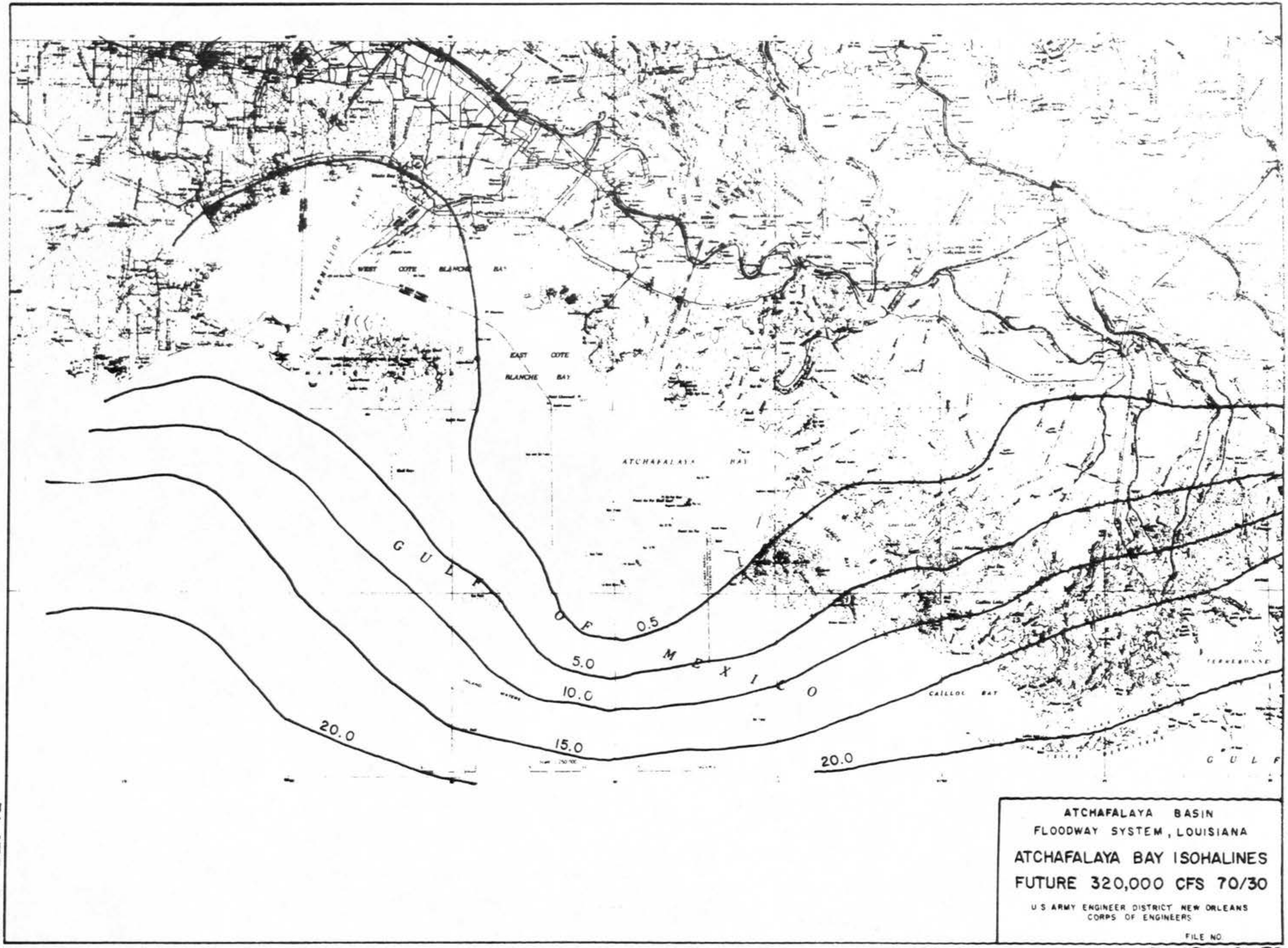
ATCHAFALAYA BAY ISOHALINES

FUTURE 90,000 CFS FWO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

PLATE C-75


WEST COTE BLANCHE BAY
VERMILLION BAY
EAST COTE BLANCHE BAY
ATCHAFALAYA BAY
GULF OF MEXICO
CAILLOU BAY
TERREBONNE
GULF
0.5
5.0
10.0
15.0
20.0
20.0
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 70/30
U S ARMY ENGINEER DISTRICT NEW ORLEANS
CORPS OF ENGINEERS
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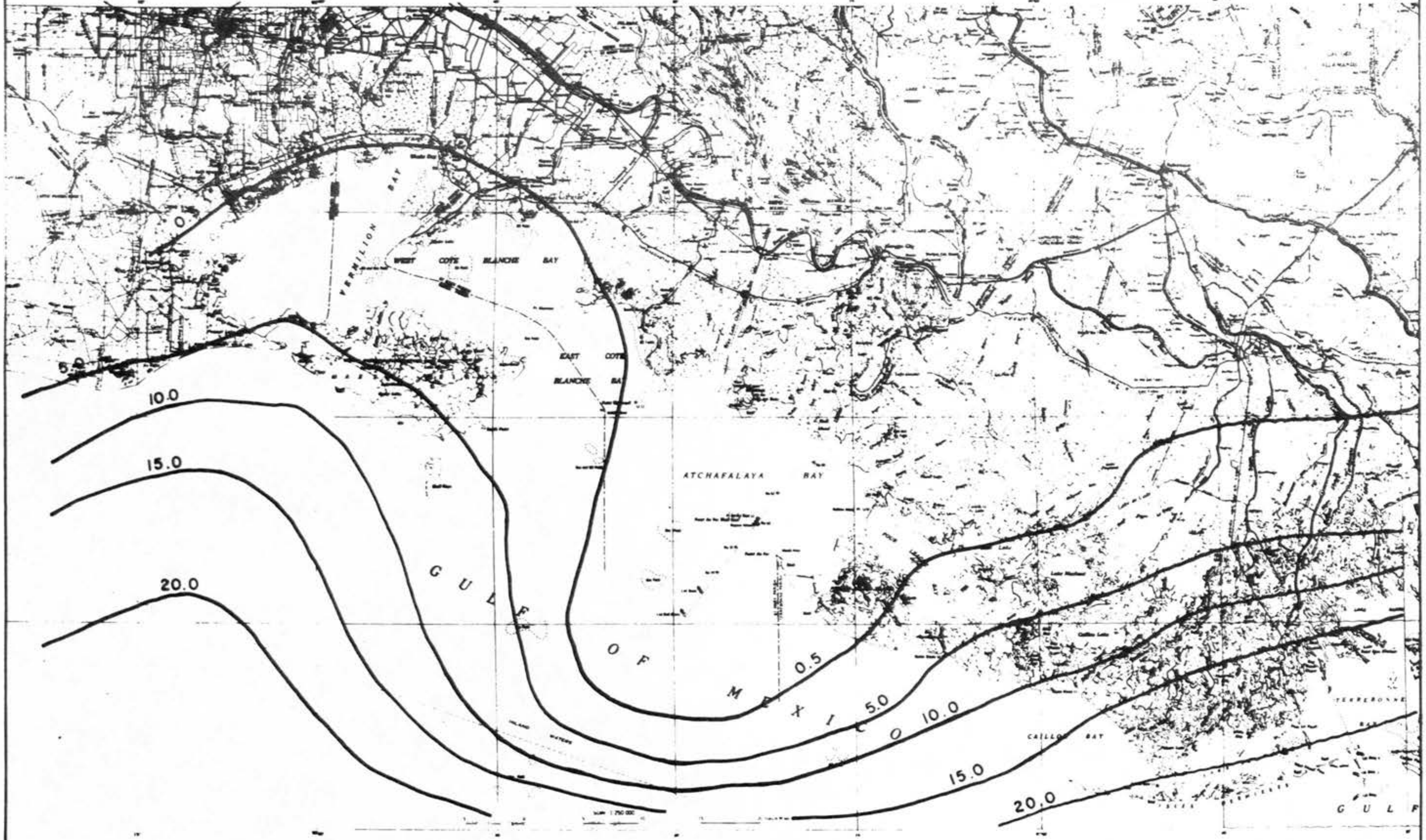


ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

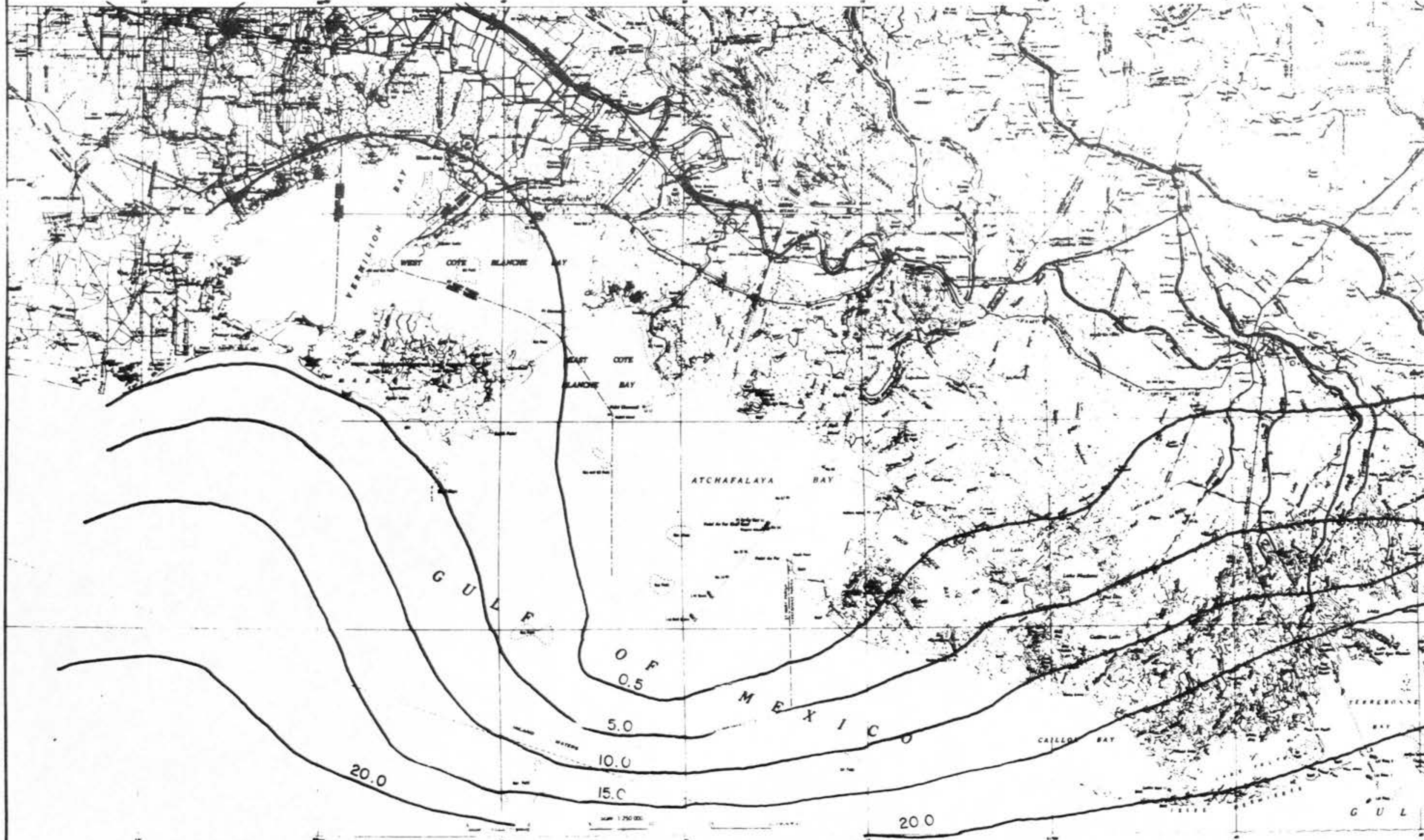
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 100/0

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-77

PLATE C-77



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

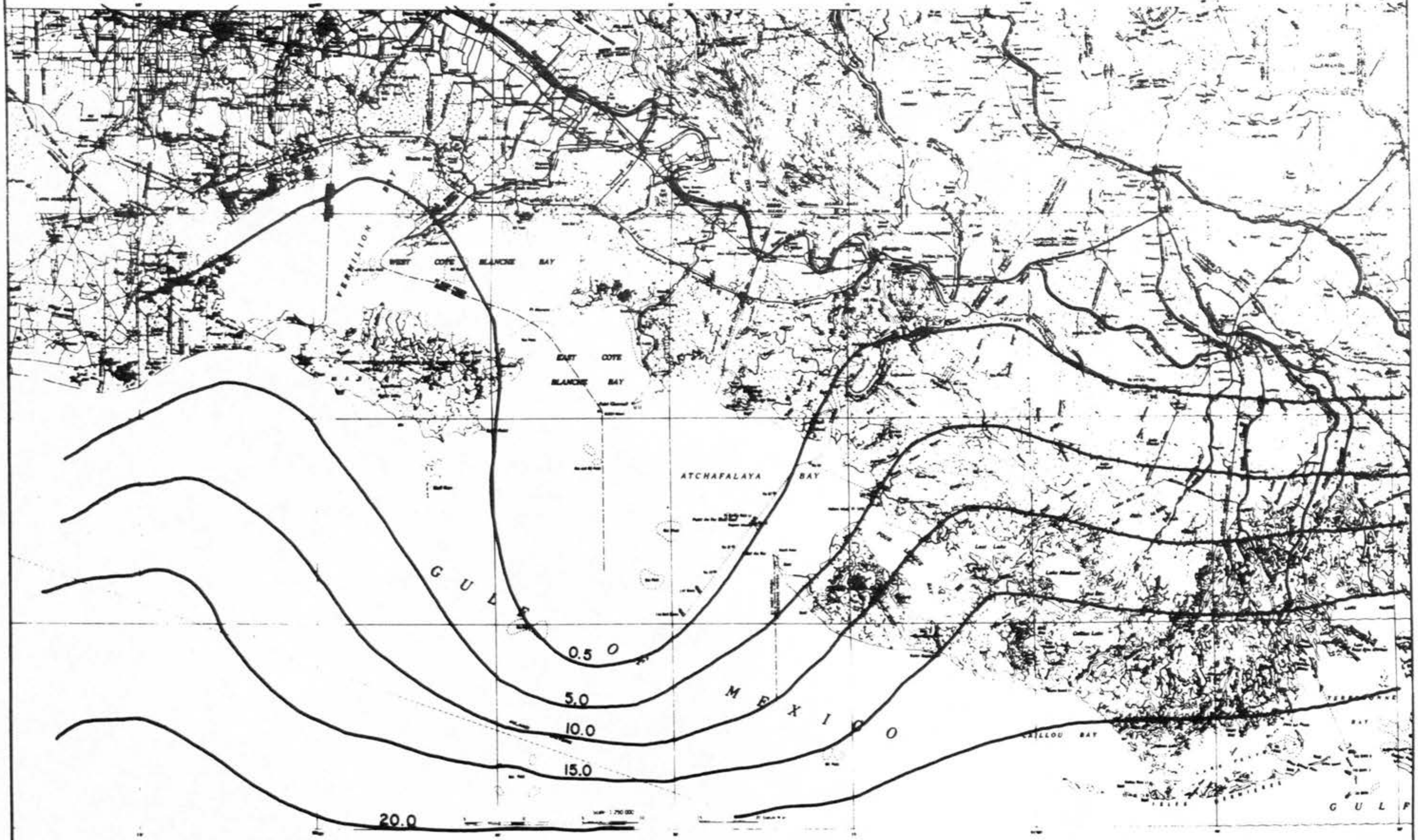
ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 80/20

U S ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO

PLATE C-78

PLATE C-78



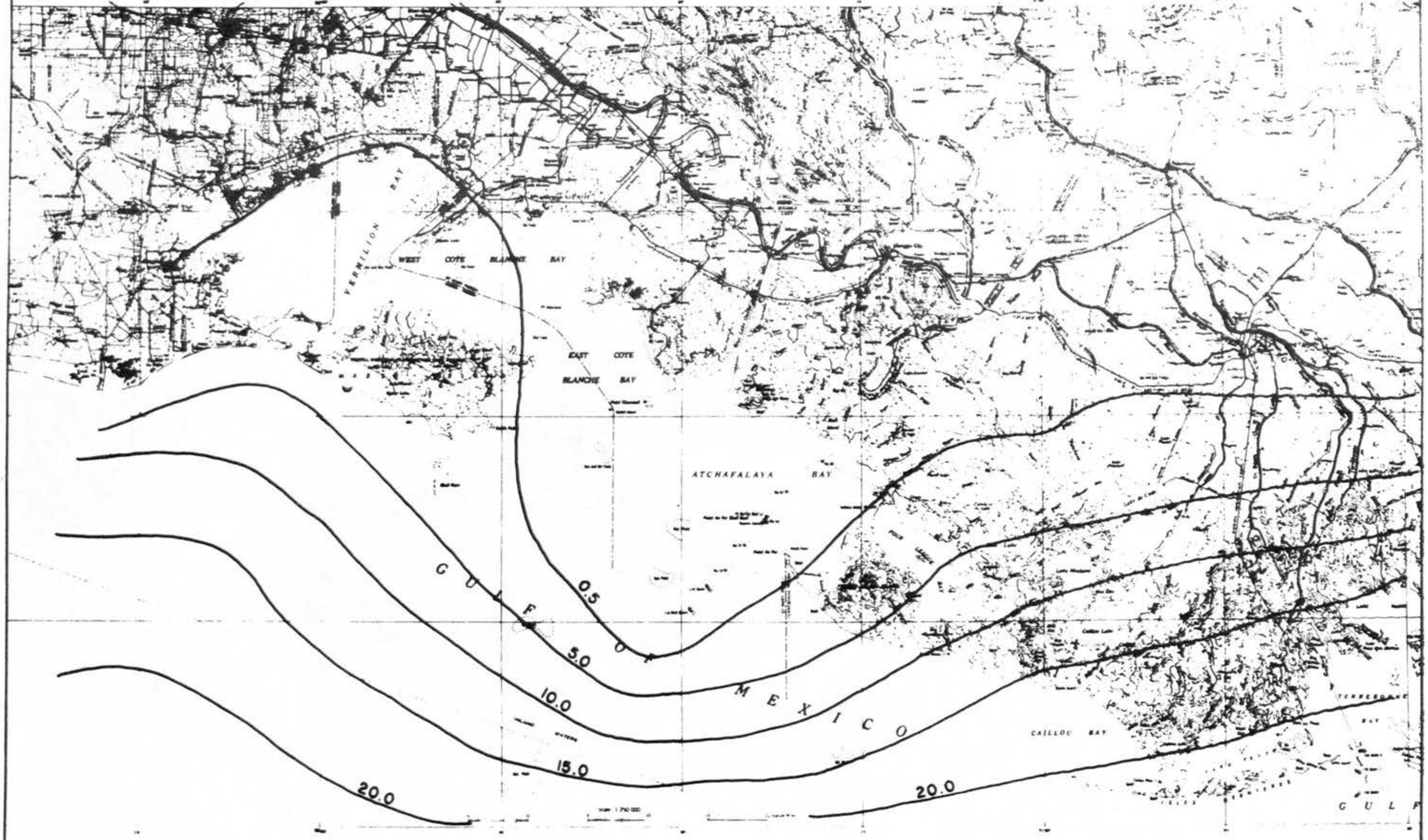
ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS 0/100

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-79



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

ATCHAFALAYA BAY ISOHALINES
FUTURE 320,000 CFS FWO

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

FILE NO.

PLATE C-80

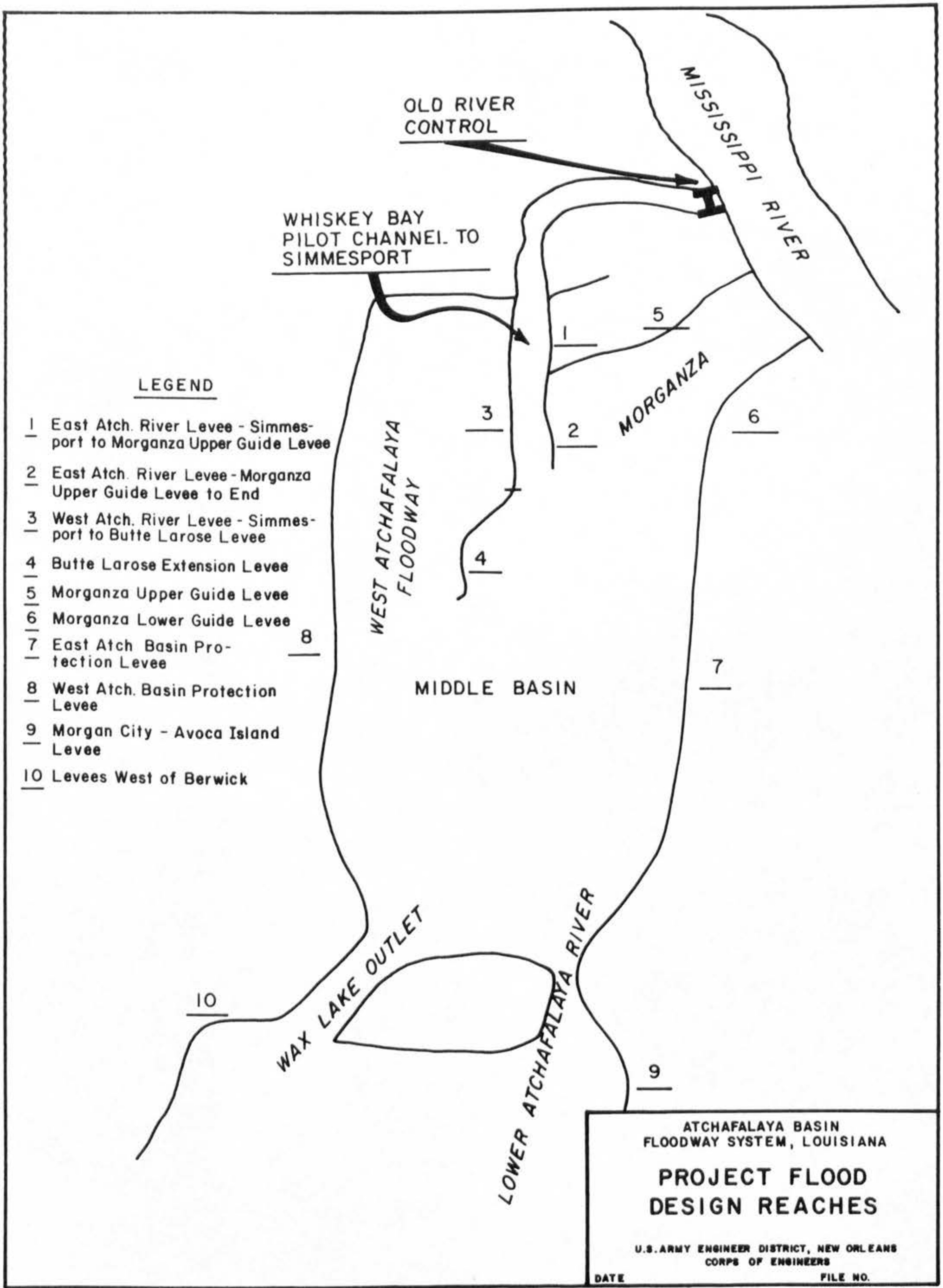
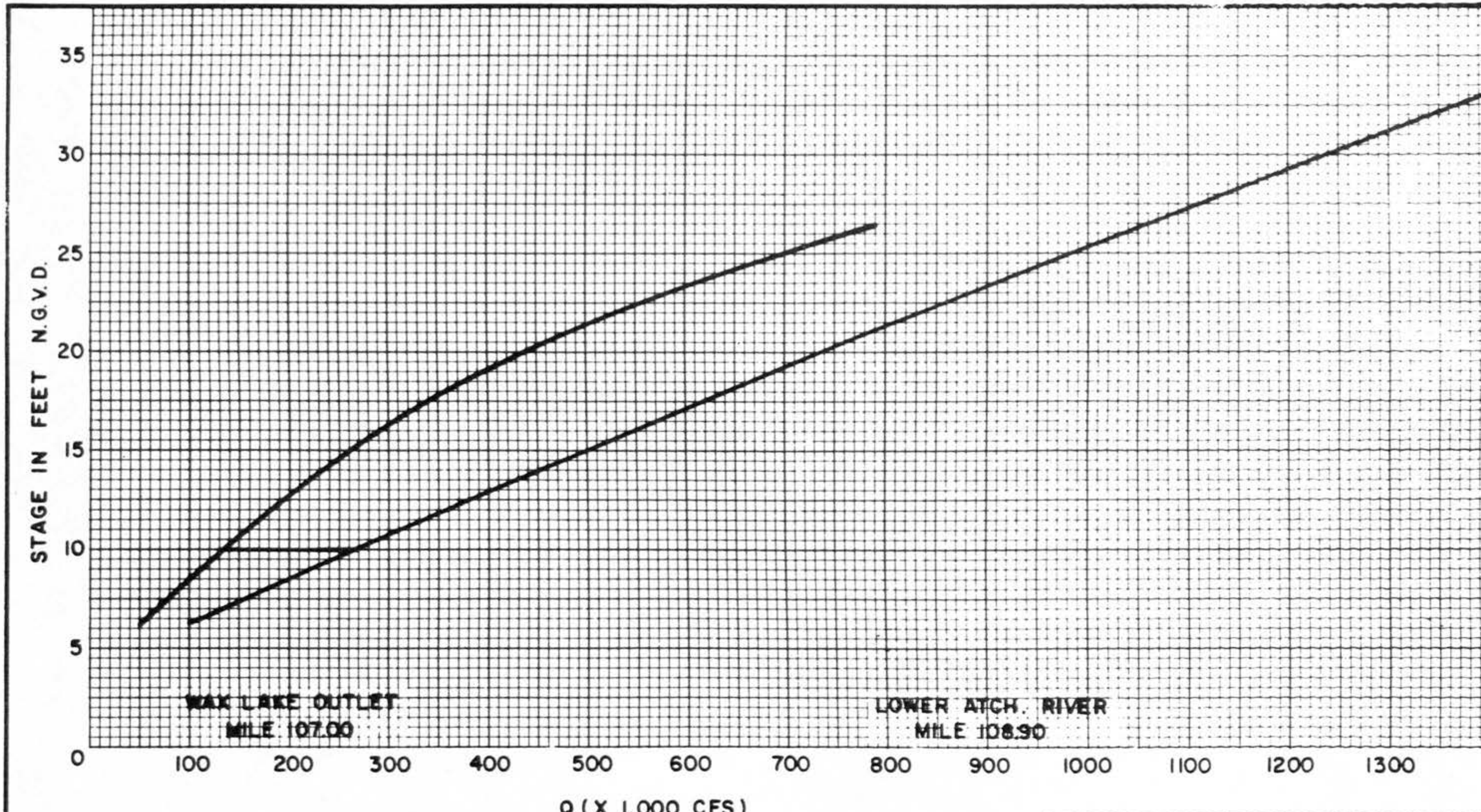

MISSISSIPPI RIVER
OLD RIVER CONTROL
WHISKEY BAY PILOT CHANNEL TO SIMMESPORT
1
5
MORGANZA
3
2
6
WEST ATCHAFALAYA FLOODWAY
4
8
7
MIDDLE BASIN
LEGEND
1 East Atch. River Levee - Simmesport to Morganza Upper Guide Levee
2 East Atch. River Levee - Morganza Upper Guide Levee to End
3 West Atch. River Levee - Simmesport to Butte Larose Levee
4 Butte Larose Extension Levee
5 Morganza Upper Guide Levee
6 Morganza Lower Guide Levee
7 East Atch Basin Protection Levee
8 West Atch. Basin Protection Levee
9 Morgan City - Avoca Island Levee
10 Levees West of Berwick
WAX LAKE OUTLET
LOWER ATCHAFALAYA RIVER
10
9
ATCHAFALAYA BASIN FLOODWAY SYSTEM, LOUISIANA
PROJECT FLOOD DESIGN REACHES
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE
FILE NO.

PLATE C-81



ATCHAFALAYA BASIN
FLOODWAY SYSTEM, LOUISIANA

COMBINED OUTLETS
RATING CURVE

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE FILE NO.

PLATE C-82

APPENDIX D

ECONOMICS

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LIST OF TABLES (CONTINUED)

LIST OF TABLES (CONTINUED)

Appendix D

ECONOMICS

D.0.1. The purpose of this study was to review the Mississippi River and Tributaries (MR&T) project to develop the optimum method for passing the project flood and to determine if changes in the project would be warranted to preserve or restore the environmental quality of the Atchafalaya Basin. Alternatives were considered in order to address the study goals of flood control and environmental preservation, which included separable features considered to be responsive to individual problem areas. The types of features considered included those to control the distribution of flows between the Mississippi and Atchafalaya Rivers; those to safely pass the project flood through the Atchafalaya Basin to the Gulf of Mexico; those to manage water levels to enhance fish and wildlife productivity in the Atchafalaya Basin; those to provide flood protection for the backwater area northeast of Morgan City; and those to acquire additional real estate interests for flood control, public access, and environmental preservation.

D.0.2. Benefit-cost ratios were not developed for the overall plan alternatives since many features of each alternative would be integral parts of the comprehensive MR&T project. The flood control features of each alternative comprised these integral features and precluded overall plan evaluation. When the flood control aspects were not considered, plan alternative evaluation was reduced to an incremental analysis of the environmental and recreation aspects of each plan. What was produced was an analysis that measured the incremental impacts of the nonflood control features, assuming the flood control features were in place. Having identified the nonflood control features and their incremental impacts, the costs of these features were disaggregated from the overall plan alternative costs. Benefit-cost ratios were then calculated, which incorporated incremental nonflood control benefits and costs.

D.0.3. The study area delineated on Figure D-0-1, encompasses three interrelated geographical and hydrological elements: the Red River backwater area; the Atchafalaya Basin Floodway system; and the Lower Atchafalaya River complex, which includes the Terrebonne marshes, the backwater area northeast of Morgan City, and the Atchafalaya Bay. The impact area for all alternatives, however, was limited to the Atchafalaya Basin Floodway system (the Lower Atchafalaya Basin Floodway in particular) and the Lower Atchafalaya River complex. Of the two areas for which impacts were evaluated, only the Atchafalaya Basin Floodway

system included nonflood control features. In the Lower Atchafalaya River complex area all impacts evaluated were the result of flood control features and did not figure in the analysis performed for each plan alternative. The analysis performed was an incremental nonflood control evaluation of the Lower Atchafalaya Basin Floodway.

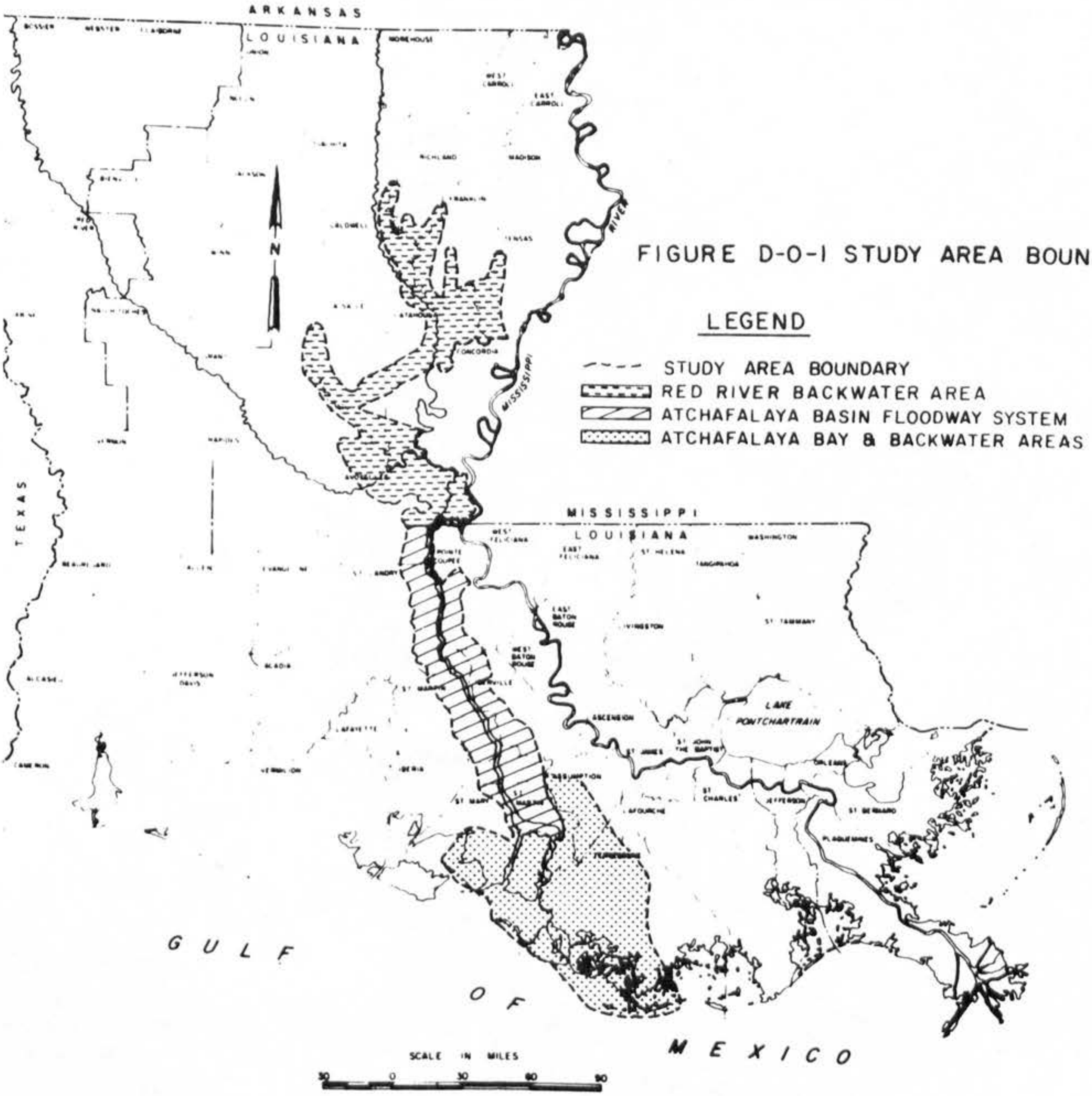

FIGURE D-0-1 STUDY AREA BOUNDARY

Section 1 - METHODOLOGY

OPERATIONAL PROCEDURES

D.1.1. Land use was the basis for computation of all benefit categories: agriculture, timber, recreation, commercial fishing, and commercial trapping. As quantities of a particular habitat which support specific economic activities change over time, so do the levels of output of the supported activities. The projection of the habitat associated with each alternative was central to the process of estimating the benefits attributable to a particular plan. In making these land-use projections, the effects of physical, as well as, economic forces were incorporated. The process of natural vegetative succession and impacts to the successional process from flowline changes, sedimentation, and water regime regulation (through management units) were several of the significant physical forces evaluated. Economic forces were also prominent factors in the projections, the most significant being the profit potential that motivates conversion of bottomland hardwoods to agricultural production. To accommodate the benefit estimation process, 10-year interval land-use acreage was projected for terrestrial and aquatic habitats. The corresponding output levels then were estimated and converted to net income equivalents, which were discounted and amortized to produce average annual net income for each activity. This procedure was completed using an October 1981 price level, a discount rate of 7-5/8 percent, and a 100-year period of analysis.

D.1.2. With respect to the land-use projections, there were several operational considerations and assumptions made that should be noted.

D.1.3. First, in addition to the area inside the Lower Atchafalaya Basin Floodway levees, the land-use acreage used to represent that area also included the area bounded by a line one-quarter mile east of the East Atchafalaya Basin Protection Levee north of Bayou Sorrel and a line one-quarter mile west of the West Atchafalaya Basin Protection Levee north of Verdunville. This allowed construction impacts, some of which would occur outside the lower floodway, to be properly accounted for. The inclusion of this area outside the guide levees added approximately 16,000 terrestrial and 3,000 aquatic acres to the total acreage figures. As a result, the absolute level of output and the corresponding net income generated for some activities was incorrectly stated by a slight amount. However, because this imprecision occurred under both the with and without-project conditions, the increments between the with and without conditions (benefits) were accurately measured.

D.1.4. Second, the land-use acreage for the Environmental Quality (EQ), Tentatively Selected (TS), and recommended plans assumed that the Buffalo Cove, Henderson Lake, Flat Lake, Cocodrie Swamp, and Beau

Bayou management units would be constructed. In fact, only the Buffalo Cove and Henderson Lake management units would be scheduled for pilot construction.

D.1.5. Third, the land-use acreage for the EQ, TS, and recommended plans, unlike the National Economic Development (NED) plan and future without-project condition, assumed a prohibition on land clearing for agricultural purposes as of 1980, although project authorization could not occur for several years. The real estate feature of these plans included a restriction on nonregenerative cutting of timber and conversion of land to another use. As a means of preserving bottomland hardwoods until project authorization and implementation could occur, it was assumed that the permitting authority (Section 404 of the Clean Water Act, 1977, PL 95-217) would be invoked to restrict specific types of development, land clearing in this case.

D.1.6. Fourth, land use was projected by decade for a period of 50 years. For the second 50 years of the 100-year period of analysis, land use was assumed to be constant as of the last projected value. The output level and the corresponding net income of all economic activities were held constant during this period. While there would be changes in land use due to both physical and economic forces during the second 50 years, the inherent difficulties in attempting to project for such an extended period of time and the minimizing effects of discounting on benefits and costs which would accrue during this period, make the procedure followed here generally accepted practice.

D.1.7. Finally, the year 1986 was selected as the first year of the project life. This was done because it would be the earliest reasonable date that authorization and appropriations could be obtained and construction begun.

Section 2 - BENEFITS

GENERAL

D.2.1. This section presents the procedures used to compute the levels of net income associated with each plan alternative for the following economic activities: agriculture, forestry, recreation, commercial fishing, and commercial trapping. Benefits to each plan were measured by the difference between the average annual net income figures with and without the plan. This section presents the net income for all economic activities for each alternative. Only those plans versus future without-project increments in average annual income that occurred as a result of nonflood control features were properly viewed as benefits for this incremental analysis of nonflood control impacts.

AGRICULTURE

D.2.2. General. Existing agricultural activity in the Lower Atchafalaya Basin Floodway is not extensive. It is limited primarily to pasture, with a small amount of acreage in soybeans. All of this activity occurs north of Interstate Highway 10 and is generally confined to the higher, more accessible grounds.

D.2.3. Bottomland Hardwoods Conversion. The most probable future without-project condition for the lower floodway involves the conversion of approximately 187,000 acres of bottomland hardwoods to agricultural production (Table D-2-1). The forces behind this significant change are both physical and economic. As shown by Figure D-2-1, the number of acres in the lower floodway that are flood free (defined here as flood free during the period 1 June to 30 November) at least three out of five years increases from approximately 236,000 acres to approximately 335,000 acres. The continued channel enlargement of the Atchafalaya River and the process of sediment deposition in the flooded overbank areas are the factors responsible for this drying-out process. More important perhaps than physical forces are the economic forces that motivate the conversion of forestland to soybean production.

D.2.4. Net Returns From Soybeans. The potential income earning capacity of the typical acre of land that could be used to grow soybeans in the lower floodway is the driving force behind the large projected conversion of forestland to agricultural production. Table D-2-2 presents the estimated costs and returns that would be generated on a typical acre. The projected land clearing shown in Table D-2-1 includes acres that would be flood free three or more out of five years. To adjust the annual net return to land and management to reflect the occurrence of flooding, which was assumed to prevent that

TABLE D-2-1

ACRES IN AGRICULTURAL PRODUCTION

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
1980	15,200	15,200	15,200	15,200	15,200
1986	23,000	23,000	15,600	15,600	15,600
1996	60,900	62,300	16,200	16,200	16,200
2006	125,000	131,000	16,700	16,700	16,700
2016	173,000	183,000	17,300	17,300	17,300
2026	196,000	210,000	17,900	17,900	17,900
2036	202,000	218,000	18,100	18,100	18,100
2086	202,000	218,000	18,100	18,100	18,100

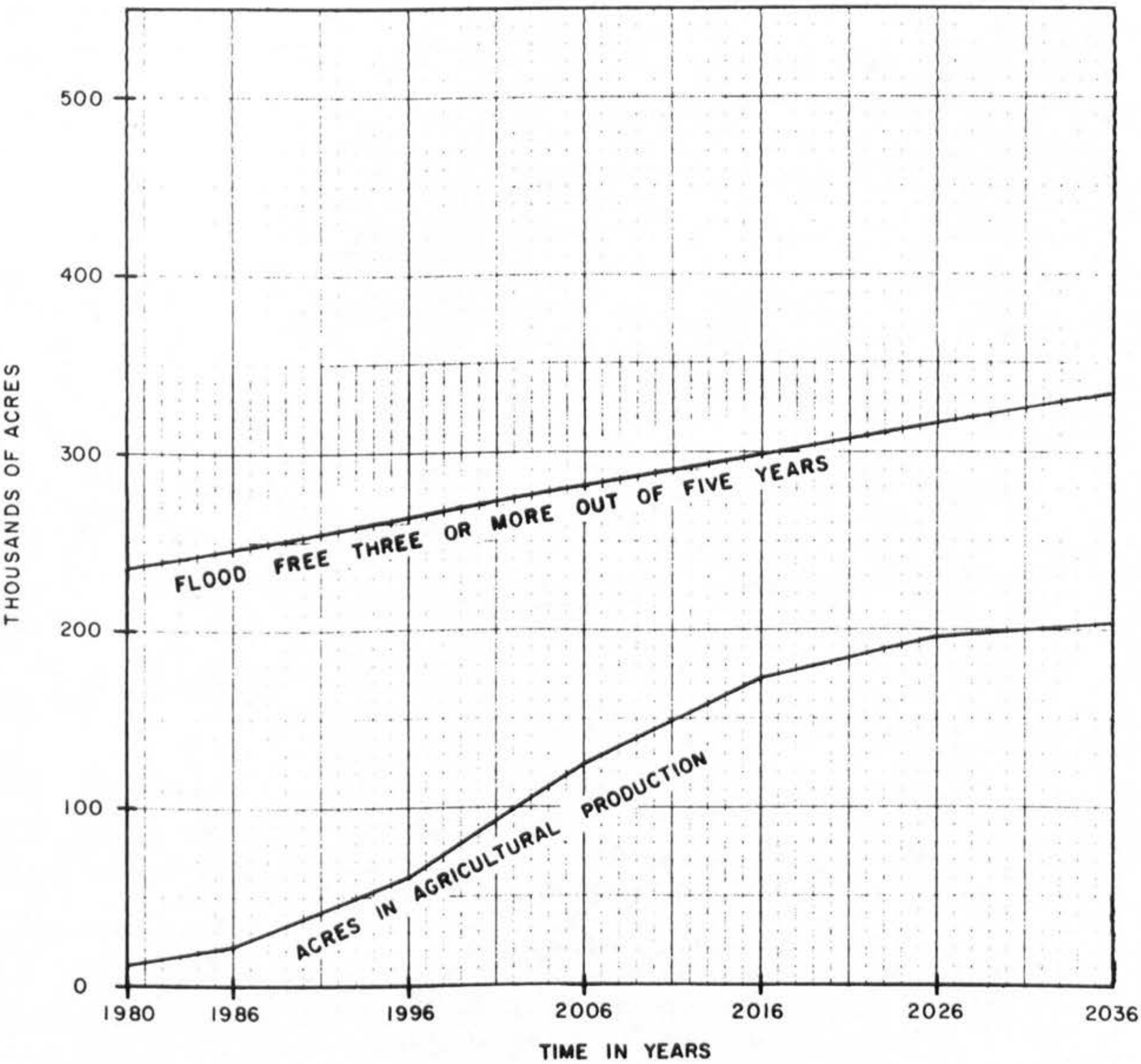

FIGURE D-2-1 MOST PROBABLE FUTURE WITHOUT PROJECT
LOWER ATCHAFALAYA BASIN FLOODWAY

TABLE D-2-2

ESTIMATED ANNUAL COSTS AND RETURNS
ON FORESTLAND CONVERTED TO SOYBEANS
(PER ACRE)

Gross Receipts $6.35/bushel x 29 bushel/acre		$184.15 1/
Variable Costs		
Preharvest	$64.54	
Harvest	$11.33	$ 75.87
Fixed Costs		$ 32.92
Total Production Costs		$108.79 2/
Net Returns to Land and Management		$ 75.36
Adjustment to Average Annual Income to Account for Occasional Flooding	(0.20 x $75.36)	$ 15.07
Flood Adjusted Average Net Return		$ 60.29
Clearing Costs		$ 25.94 3/
Fully Costed Average Net Return		$ 34.35

1/ $6.35/bushel price is the Water Resources Council 1981 normalized price for soybeans in Louisiana; 29 bushel/acre yield is the composite 1975-78 average yield for Iberville, Pointe Coupee, St. Landry, and St. Martin Parishes.
2/ Crop budget data developed by Louisiana State University.
3/ Annual clearing cost is based on an initial cost of $340/acre amortized at 7-5/8 percent for a period of 100 years.

year's crop, the average net return must be reduced. As an absolute maximum, this reduction would be 40 percent, the two out of five years when flooding occurs. The actual reduction, however, should be less than 40 percent. This is due to several reasons. First, not all lands projected to be cleared would flood two out of five years. Some would flood only one out of five, while others would not flood at all. Second, the flood frequency of lands cleared early would continue to be reduced as the area became drier over time. If an acre flooded one out of five years at the time of its clearing, its flood frequency could decrease to none out of five over time as conditions changed. A third consideration is the assumption regarding flooding. If land has water on it after 1 June, it was assumed there would be no crop that year. If, however, the waters recede shortly after 1 June it would be possible to plant late and receive reduced yields, yet still generate positive net income. For these reasons, it was assumed that the average frequency of flooding on future cleared lands would be one out of five years. This would result in an average net return to land and management that would be 20 percent less than the annual net return figure.

D.2.5. It is profit potential that motivates a landowner to convert his land to soybean production. The flood adjusted average net return from soybean production, as presented in Table D-2-2, is approximately $60 per acre. Alternatives to soybean production do not provide comparable levels of income. Net returns from forestry (on a sustained yield basis) are approximately $15 to $20 per acre, while annual net returns from hunting leases are limited between $2 to $4 per acre. At best, a private landowner can earn on average approximately $20 per acre (exclusive of mineral income) on an acre of bottomland hardwoods. This means that landowners could earn in excess of $40 per acre net of opportunity cost. The present value of a $40 annuity for 100 years at 7-5/8 percent is equal to approximately $525. Given an initial conversion cost for land clearing and preparation of approximately $340 per acre, it is apparent that the profit-maximizing landowner would convert his land from forestland to soybean production, since the landowner's benefit-cost evaluation does not take into account externalized benefits or costs that do not accrue to him.

D.2.6. Table D-2-3 presents the net income that would be generated by the conversion of forestland to soybean production under the future without-project condition.

D.2.7. NED Plan. Compared to the future without-project condition, the NED plan generates a lower flowline in the Lower Atchafalaya Basin Floodway. This would accelerate and amplify the physical forces responsible for the drying-out process and would render additional acres of bottomland hardwoods subject to potential conversion. As a result, a larger number of acres would be in soybean production (see Table D-2-1).

TABLE D-2-3

NET RETURNS FROM SOYBEAN PRODUCTION FOR
FUTURE WITHOUT-PROJECT CONDITION

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	23,000	40.04	921,000
1996	60,900	43.49	2,649,000
2006	125,000	40.04	5,005,000
2016	173,000	36.39	6,295,000
2026	196,000	35.17	6,893,000
2036	202,000	34.35	6,939,000
2086	202,000	34.35	6,939,000
1986-2086 Average Annual			3,173,000

[1/]After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

D.2.8. The net income generated from soybean production under the NED plan is presented in Table D-2-4. The increase in net returns for the 50-year period, 1986-2036, is dramatic, showing a greater than eight-fold increase. This increase, however, when viewed against the without-project condition, is only slightly greater than would otherwise occur.

D.2.9. EQ, TS, and Recommended Plans. The EQ, TS, and recommended plans would prevent the conversion of bottomland hardwoods to agricultural production in the lower floodway. As part of a real estate package, which includes flood control and environmental easements, these plans would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. This prohibition would extend generally over the entire lower floodway. The profit motive for conversion of forestland to agricultural production would not be removed, but it would be legislatively neutralized. Table D-2-5 presents the agricultural net income associated with the EQ, TS, and recommended plans.

D.2.10. Table D-2-5 requires two explanatory notes. As previously discussed under methodology, the EQ, TS, and recommended plans assumed no land clearing within the lower floodway after 1980. This assumption explains the apparent inconsistency between alternatives of a different number of acres in production at the start of the project life. Land clearing would occur during the period 1980 to 1986 with the future without-project condition and with the NED plan but not with the EQ, TS, and recommended plans. The second clarification concerns the slight increase in acres in production and the corresponding increase in net returns. Again, as discussed previously, the land-use figures provided for the lower floodway included a small amount of acreage outside the floodway levees. It is on this land outside the floodway levees that the land conversion and increase in production will occur. This explains how acres in production could increase in view of the restriction on land conversion in the lower floodway.

D.2.11. Summary. The variance in average annual agricultural net income between plans would be substantial. Table D-2-6 presents these differences. As can be seen, the NED plan, which would have the greatest net income, is nearly six times greater than the EQ, TS, or recommended plans.

TIMBER

D.2.12. Evolution of Atchafalaya Basin Logging. Prior to 1890, cypress was cut in anticipation of the spring high water. There were few protection levees in Louisiana at that time and most of the south Louisiana swamps were flooded each spring by high waters from the Mississippi River and its distributaries. Timber cutters worked

TABLE D-2-4

NET RETURNS FROM SOYBEAN PRODUCTION FOR
THE NED PLAN

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	23,000	40.04	921,000
1996	62,300	43.49	2,709,000
2006	131,000	40.24	5,271,000
2016	183,000	36.39	6,659,000
2026	210,000	35.36	7,426,000
2036	218,000	34.35	7,488,000
2086	218,000	34.35	7,488,000
1986-2086 Average Annual			3,312,000

[1/] After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

TABLE D-2-5

NET RETURNS FROM SOYBEAN PRODUCTION FOR THE EQ, TS, AND RECOMMENDED PLANS

Year	Acres In Production	Average Net Returns Per Acre[1/]	Net Returns
		($)	($)
1986	15,600	34.75	542,000
1996	16,200	34.75	563,000
2006	16,700	34.75	580,000
2016	17,300	34.75	601,000
2026	17,900	34.75	622,000
2036	18,100	34.35	622,000
2086	18,100	34.35	622,000
1986-2086 Average Annual			569,000

[1/] After initial conversion to soybean production, the productivity of the land is above average for a period of approximately five years. Yields during this period would be about one standard deviation above the mean value or 33 bushels per acre (see footnote 1, Table D-2-2). At this higher yield, the fully costed average net return per acre would be $54.67. The average net return per acre value presented here is the weighted average of acres considered "cleared within the last five years," with net returns per acre of $54.67 and "not cleared within the last five years," with net returns per acre of $34.35.

TABLE D-2-6

SUMMARY OF NET RETURNS FROM AGRICULTURE

Year	Future Without-Project	Plan NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	921,000	921,000	542,000	542,000	542,000
1996	2,649,000	2,709,000	563,000	563,000	563,000
2006	5,005,000	5,271,000	580,000	580,000	580,000
2016	6,295,000	6,659,000	601,000	601,000	601,000
2026	6,893,000	7,426,000	622,000	622,000	622,000
2036	6,939,000	7,488,000	622,000	622,000	622,000
2086	6,939,000	7,488,000	622,000	622,000	622,000
1986-2086 Average Annual	3,173,000	3,312,000	569,000	569,000	569,000

through the winter and early spring felling and bucking the trees prior to the yearly high water. When the water rose, the logs were floated through the network of bayous to the principal stream of navigation where the logs were rafted together and towed to the sawmills. At times, the spring rise failed to come and logs had to lie in the swamps for an entire year. This caused heavy losses and often the sawmills were shut down because no logs were available.

D.2.13. As the cypress lumber industry developed, the experienced operators began to seek new solutions to the access and transport problem. With the invention of the "pullboat," the sawmills were no longer dependent on the annual high water and were unaffected by droughts.

D.2.14. The "pullboat," invented by William Baptist of New Orleans in 1889, was capable of pulling logs one-half mile and two others built later would each pull 3,000 feet. In 1891, the Louisiana Cypress Lumber Company of Harvey inaugurated the first pullboat, followed by the first overhead skidder. The Louisiana Red Cypress Company of Patterson and the Ruddock Cypress Company of Ruddock, in 1892 and 1894, respectively, replaced the pullboat with the railroad skidder. Because of low first cost and efficiency, this method replaced virtually all others.

D.2.15. The next improvement in logging was the "Baptist" type overhead skidder, built by Woodward, Wight and Company of Louisiana. Patents of these machines were obtained by Lidgerwood Manufacturing Company of New York and were known locally as Lidgerwood skidders. The overhead cableway skidder was universally used in the swamps of south Louisiana. These tree-rigged skidders could log a million board feet a month with an average crew of 17 at a cost of less than one dollar per thousand.

D.2.16. Thus, logging progressed from the float in the 1880's to the pullboat in the 1890's, and from that to the overhead cableway skidder, which was used until the supply of virgin cypress was exhausted in the 1920's.

D.2.17. Present Logging Methods. Present-day swamp logging in the cypress-tupelo areas of south Louisiana is limited chiefly to two methods: truck hauling and water transportation by barge, the latter being generally more expensive.

D.2.18. Typically, the timber is first cut with power saws. Cables, called chokers, are next placed on the logs and several logs are hooked together behind an amphibious vehicle known as a bombadier. These logs are then skidded to a loading point on a road; the choker cables are detached and the logs are loaded on a truck by means of a hydraulic loader. This type logging is generally limited to areas within one-half mile of the access road, since it is not practical to

skid logs for distances greater than 2,500 feet. These vehicles are relatively slow and maintenance costs are high. A typical truck haul logging operation using bombadiers for skidders will produce about 10,000 board feet per day. Minimum timber volumes per acre to economically justify this type logging are in the range of 2,000 to 2,500 board feet.

D.2.19. The other type logging method commonly used in south Louisiana involves transporting the logs by barge. With this method, the timber is cut in the usual manner and skidded to the bank of a navigable stream or canal by use of bombadiers or barge-mounted, long-line skidders. When bombadiers are used, the logs are hooked to the machine with cable chokers and pulled to the stream bank where a barge-mounted loader places them onto a barge. The long-line skidder is sometimes used instead of the bombadier. This is a diesel-powered machine that utilizes cables for skidding logs from the woods to the river bank. Most present-day long-line skidders can pull logs a maximum distance of about 1,500 feet; however, there are heavy-duty machines capable of pulling distances up to 3,000 feet. None of these larger machines are presently operating in south Louisiana.

D.2.20. In a very few cases, accessibility can be achieved by constructing board roads or canals. The cost, however, is almost always prohibitive, since there is little timber in south Louisiana today that would justify the $8-10 per linear foot construction costs for board roads or canals. Because skidding distances are limited to a maximum of 2,500 feet, roads have to be spaced at about one-mile intervals. The cost of this approximates $80.00 per acre. As with board roads, the canals should be no farther than one mile apart; this entails a cost of about $65.00 per acre. Timber volume per acre would have to exceed 5,000 board feet to justify construction of either logging canals or board roads.

D.2.21. In recent years, a new method for harvesting south Louisiana cypress-tupelo areas has been initiated. This new method involves cutting the timber in the usual manner and transporting it with the use of helicopters. This practice, while relatively new, is currently being used to supply a recently constructed sawmill in the area. If this new method of helicopter harvest proves viable, it could have a significant impact on the merchantability of many previously inaccessible areas.

D.2.22. On the bottomland hardwood areas in the northern portions of the lower floodway, conventional track logging utilizing rubber-tired skidders occurs on the more accessible areas.

D.2.23. Net Returns to Logging. It is apparent from the preceding discussion that not all of the total standing timber in the basin at present is considered to be "merchantable", i.e., it could actually be sold on the open market. Considering current timber prices, logging

costs, and the factors previously discussed, the harvestable timber resource (merchantable) is severely limited. For this analysis, two basic criteria were used in establishing merchantability: the minimum volume per acre must exceed 2,000 board feet; and the timber must be located within some 2,500 feet of a navigable stream or roadway. Timber acreage meeting these criteria range from a high of 80 percent in the Alabama Bayou management unit to a low of 30 percent in the southernmost management units.

D.2.24. Timber acreage was further subdivided into two classes: late successional bottomland hardwoods (LSBLHW), which occur on higher lands, and, other timber, which includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW and CT, and acreage of unknown composition. Each of these two main classes has been assigned specific merchantable percentages and net return values.

D.2.25. Impacts of the various plans on the amount of timber acreage identified as merchantable were estimated on a decade basis and the resulting changes in annual net returns reduced to an average annual figure, using present worth (discount) methods. Projection rationale and other values for the discounting parameters are discussed in the section on methodology.

D.2.26. The chief impacts associated with each alternative plan, as compared to the future without-project condition, have been identified by different future flowlines of the river and the related effects therefrom on vegetative succession, and by the various real estate easement proposals that will regulate future land uses.

D.2.27. Future Without-Project Condition. The most probable future without-project condition for the lower floodway involves the conversion of approximately 187,000 acres of bottomland hardwoods to agricultural production. The forces behind this significant change are both physical and economic. As discussed under agriculture, the number of acres in the lower floodway that are flood free at least three out of five years increases from approximately 236,000 acres to approximately 335,000 acres. The continued channel enlargement of the Atchafalaya River and the process of sediment deposition in the flooded overbank areas are the factors responsible for this drying-out process. In addition, there are powerful economic forces that motivate the conversion of forestland to soybean production. This also is discussed in the preceding section on agriculture.

D.2.28. The combined impacts discussed previously would result in projected merchantable acreage of LSBLHW and other timber classes as shown in Table D-2-7, and an average annual net return of $3,047,000 as shown in Table D-2-8.

D.2.29. NED Plan. No restrictions on land conversions are included in the NED Plan, thus the same profit incentives for conversion of forestlands to agriculture as described in the future without-project

TABLE D-2-7

MERCHANTABLE[1/] TIMBER ACREAGE
FUTURE WITHOUT-PROJECT CONDITION

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	126,500	95,000
1996	112,500	91,400
2006	84,500	89,300
2016	65,500	87,500
2026	57,000	86,400
2036	55,000	86,400
2086	55,000	86,400

1/ Recoverable.
2/ Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-8

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
FUTURE WITHOUT-PROJECT CONDITION

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,530,000	1,045,000	3,575,000
1996	2,250,000	1,006,000	3,256,000
2006	1,690,000	982,000	2,672,000
2016	1,310,000	962,000	2,272,000
2026	1,140,000	950,000	2,090,000
2036	1,100,000	950,000	2,050,000
2086	1,100,000	950,000	2,050,000
1986-2086 Average Annual			3,047,000

[1/]Recoverable.
[2/]Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

condition would operate. Further, the NED plan would generate a lower flowline in the Lower Atchafalaya Floodway as compared to the future-without project. This would accelerate and amplify the drying-out process and would result in additional clearing of merchantable timber. The combined effect of the above, summarized on Table D-2-9 and D-2-10, would result in an annual net return to timber of $3,021,000 for this plan.

D.2.30. EQ, TS, and Recommended Plans. The EQ, TS, and recommended plans would prevent the conversion of bottomland hardwoods to agricultural production in the lower floodway. As part of a real estate package, which includes flood control and environmental easements, these plans would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. This prohibition would extend generally over the entire lower floodway. The profit motive for conversion of forestland to agricultural production would not be removed but it would be legislatively neutralized. Tables D-2-11 through D-2-16 present the acreage of timber and the net income from timbering associated with the EQ, TS, and recommended plans. Annual income from the EQ and TS plans amounts to $3,112,000 and $3,113,000, respectively. The slight difference between the two plans comprised a minor difference in construction impacts to timber acreage associated with each plan. Annual income from the recommended plan amounts to $3,077,000. The difference in annual income between the recommended and the two previously mentioned plans occurs due to a difference in the number of acres on which silviculture would be prohibited as part of real estate easements.

D.2.31. Summary. The impacts of each alternative plan on the net income (return) to timbering operations in the floodway represent a range of approximately 3 percent between the least impacting plan and the most impacting plan, as summarized in Table D-2-17.

RECREATION

D.2.32. General. The Lower Atchafalaya Basin Floodway offers diverse recreational opportunities to satisfy the pursuits of a wide spectrum of outdoor enthusiasts. The two major recreational activities, hunting and fishing, are sustained by the great abundance of wildlife and fishery resources of the area.

D.2.33. Of approximately 590,000 acres that lie within the lower floodway below US Highway 190, approximately 80 percent is in private ownership. More than 250 private hunting clubs have their own permanent camps in the northern portion of this area (Miller, personal communication). Many of these clubs lease lands from private landowners on an annual basis. Public hunting is restricted more to state-owned lands, such as the Attakapas and Atchafalaya Delta Wildlife Management Areas or to public water bodies.

TABLE D-2-9

MERCHANTABLE[1/] TIMBER ACREAGE
NED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	126,500	95,000
1996	112,000	91,400
2006	83,000	88,600
2016	62,500	85,700
2026	53,500	83,900
2036	51,000	83,500
2086	51,000	83,500

1/Recoverable.
2/Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-10

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
NED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,530,000	1,045,000	3,575,000
1996	2,240,000	1,006,000	3,246,000
2006	1,660,000	974,000	2,634,000
2016	1,250,000	942,000	2,192,000
2026	1,070,000	923,000	1,993,000
2036	1,020,000	919,000	1,939,000
2086	1,020,000	919,000	1,939,000
1986-2086 Average Annual			3,021,000

1/Recoverable.
2/Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-11

MERCHANTABLE[1/] TIMBER ACREAGE
EQ PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage
1986	108,000	84,200
1996	111,000	81,700
2006	110,500	82,400
2016	110,000	83,900
2026	109,500	85,300
2036	109,500	86,000
2086	109,500	86,000

[1/] Recoverable.
[2/] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-12

NET RETURNS FROM MERCHANTABLE[1] TIMBER
EQ PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2] Acreage	Total
	($)	($)	($)
1986	2,160,000	927,000	3,087,000
1996	2,220,000	899,000	3,119,000
2006	2,210,000	907,000	3,117,000
2016	2,200,000	923,000	3,123,000
2026	2,190,000	939,000	3,129,000
2036	2,190,000	946,000	3,136,000
2086	2,190,000	946,000	3,136,000
1986-2086 Average Annual			3,112,000

1/ Recoverable.
2/ Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-13

MERCHANTABLE[1] TIMBER ACREAGE
TS PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2] Acreage
1986	108,000	84,200
1996	111,000	81,700
2006	110,500	82,400
2016	110,000	84,200
2026	110,000	85,700
2036	110,000	86,400
2086	110,000	86,400

[1] Recoverable.
[2] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-14

NET RETURNS FROM MERCHANTABLE [1] TIMBER
TS PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2] Acreage	Total
	($)	($)	($)
1986	2,160,000	927,000	3,087,000
1996	2,220,000	899,000	3,119,000
2006	2,210,000	907,000	3,117,000
2016	2,200,000	927,000	3,127,000
2026	2,200,000	942,000	3,142,000
2036	2,200,000	950,000	3,150,000
2086	2,200,000	950,000	3,150,000
1986-2086 Average Annual			3,113,000

[1] Recoverable.
[2] Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-15

MERCHANTABLE[1] TIMBER ACREAGE
RECOMMENDED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2] Acreage
1986	106,000	84,600
1996	109,000	82,100
2006	108,500	82,800
2016	108,000	84,600
2026	108,000	86,000
2036	108,000	86,800
2086	108,000	86,800

1/ Recoverable.
2/ Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-16

NET RETURNS FROM MERCHANTABLE[1/] TIMBER
RECOMMENDED PLAN

Year	Late Successional Bottomland Hardwoods Acreage	Other Timber[2/] Acreage	Total
	($)	($)	($)
1986	2,120,000	931,000	3,051,000
1996	2,180,000	903,000	3,083,000
2006	2,170,000	911,000	3,081,000
2016	2,160,000	931,000	3,091,000
2026	2,160,000	946,000	3,106,000
2036	2,160,000	954,000	3,114,000
2086	2,160,000	954,000	3,114,000
1986-2086 Average Annual			3,077,000

[1/]Recoverable.
[2/]Other Timber includes early successional bottomland hardwoods (ESBLHW), cypress-tupelo (CT), mixed ESBLHW/CT, and acreage of unknown composition.

TABLE D-2-17

SUMMARY OF NET RETURNS FROM MERCHANTABLE[1/] TIMBER

Year	Future Without-Project	Plan NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	3,575,000	3,575,000	3,087,000	3,087,000	3,051,000
1996	3,256,000	3,246,000	3,119,000	3,119,000	3,083,000
2006	2,672,000	2,634,000	3,117,000	3,117,000	3,081,000
2016	2,272,000	2,192,000	3,123,000	3,127,000	3,091,000
2026	2,090,000	1,993,000	3,129,000	3,142,000	3,106,000
2036	2,050,000	1,939,000	3,136,000	3,150,000	3,114,000
2086	2,050,000	1,939,000	3,136,000	3,150,000	3,114,000
1986-2086 Average Annual	3,047,000	3,021,000	3,112,000	3,113,000	3,077,000

1/ Recoverable.

D.2.34. Since the open water of the lower floodway is public domain, fishing occurs on a year-round basis throughout the area but is more concentrated in the southern part. Both sport and rough fish are taken.

D.2.35. Several commercial campgrounds are located in the project area. Campgrounds generally offer sites having electrical hookups, water and sanitation facilities and, in some instances, boat-launching ramps to enter the basin.

D.2.36. The Lower Atchafalaya Basin Floodway, because of its environmental uniqueness and its classification as Louisiana's largest river swamp, provides a focal point for the pursuit of many nonconsumptive recreational activities. Nature seekers engage in canoeing, photography, nature study, and exploring. Such visitors seek out the scenic semi-wilderness areas of hardwood forests, cypress swamps, marshes, and bayous that teem with a wide diversity of flora and fauna. Commercial operations, catering to the nature enthusiast, are increasing and offer such services as basin tours and guided canoe outings.

D.2.37. Evaluated Impacts. The evaluated impacts to existing recreational activities in the lower floodway resulted from two plan-induced factors: land-use (habitat) changes and the construction of specific recreation features, which would constitute a recreation development plan.

D.2.38. The impacts of land-use changes were evaluated for only three activities: big game hunting, small game hunting, and waterfowl hunting. Habitat types were projected in 10-year intervals and along with the biological carrying capacities associated with each habitat type, the man-days of supply generated for each hunting activity were estimated. The man-days of supply were converted to monetary terms by multiplying the estimated supply by unit-day prices for each activity.

D.2.39. The impacts of the recreation development plan were evaluated by estimating the number and type of recreational visitations that would be generated by construction of the associated features and facilities. These visitations would be over and above the level of each activity that would occur in the absence of plan implementation. Having estimated annual visitations, the annual monetary value of the various activities was computed by multiplying the visitations by the unit price of each activity.

D.2.40. Appendix F, Recreation Resources, provides a detailed presentation of the recreation impacts as well as a complete description of the recreation development features. Appendix F includes calculation of the man-days of supply for each alternative and the annual visitations generated by the recreation development plan. For a discussion of the unit-day values applied to the computed

man-days of supply and annual recreation development visitations, refer to the Summary of Related Studies section of this appendix.

D.2.41. The recreation impacts of the future without-project condition are presented in Table D-2-18. The without-project condition does not incorporate recreation development features; therefore, the impacts evaluated were limited to changes in the man-days of supply for the three hunting activities. As Table D-2-18 shows, the man-days of supply would decrease over time for all activities. The primary reason for this projected decline is the drying-out process that is currently underway in the lower floodway. As the Atchafalaya River enlarges its main channel and the process of sediment deposition in the overbank areas continues, habitat that supports wildlife would be lost as bottomland hardwoods become suitable for agriculture and are converted to soybean production.

D.2.42. NED Plan. The NED plan would result in similar losses of wildlife habitat as with the future without-project condition. These losses would be slightly greater than the future without-project condition as the lower flowline associated with the NED plan allows a greater amount of bottomland hardwoods to be converted to agricultural production. Table D-2-19 presents a summary of the recreation impacts associated with the NED plan, including the impacts of the recreation development features that would be a part of the NED plan.

D.2.43. EQ, TS, and Recommended Plans. These plans would incorporate real estate easements, which would prohibit non-regenerative timber cutting and land clearing for conversion to other land uses. These easements would extend generally over the entire lower floodway and would work to preserve the wildlife-supporting habitat. In addition, the EQ and TS plans would also provide public access to approximately 50,000 acres of cypress-tupelo and 30,000 acres of bottomland hardwood habitat, while the recommended plan would provide public access to approximately 12,000 acres of cypress-tupelo and 66,000 acres of bottomland hardwood habitat. Higher biological carrying capacities resulting from wildlife management practices on these acres would generate a larger number of man-days of supply when compared to the future without-project condition for these acres.

D.2.44. Tables D-2-20, D-2-21, and D-2-22 present the respective man-days of supply for the EQ, TS, and recommended plans. The man-days of supply presented were adjusted to reflect that no hunting would occur on approximately 1,500 acres purchased in fee, which would be required for implementation of the recreation development features. The impacts of the recreation development features are also presented in Tables D-2-20 through D-2-22.

TABLE D-2-18

RECREATION SUMMARY
FOR FUTURE WITHOUT-PROJECT CONDITION

Year	User Days Supplied			Total Value[1/] ($)
	Big Game	Small Game	Waterfowl	
1986	77,200	60,900	1,900	4,227,000
1996	70,400	56,400	1,800	3,871,000
2006	58,300	50,100	1,600	3,266,000
2016	50,000	45,300	1,400	2,841,000
2026	46,400	43,100	1,400	2,657,000
2036	45,700	42,700	1,400	2,622,000
2086	45,700	42,700	1,400	2,622,000
1986-2086 Average Annual				3,648,000

[1/]Total value represents the total of the three hunting activities discussed previously. Other recreation activities, such as fishing and general recreation, are not included.

TABLE D-2-19

RECREATION SUMMARY FOR THE NED PLAN

	User Days Supplied				Recreation Development[1/] Annual Visitations			
Year	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	77,200	60,900	1,900	4,227,000	705,500	320,100	16,551,000	20,778,000
1996	70,700	57,000	1,800	3,894,000	705,500	320,100	16,551,000	20,445,000
2006	58,000	49,500	1,500	3,241,000	705,500	320,100	16,551,000	19,792,000
2016	48,900	44,200	1,400	2,778,000	705,500	320,100	16,551,000	19,329,000
2026	45,000	41,900	1,300	2,577,000	705,500	320,100	16,551,000	19,128,000
2036	44,000	33,400	1,300	2,393,000	705,500	320,100	16,551,000	18,944,000
2086	44,000	33,400	1,300	2,393,000	705,500	320,100	16,551,000	18,944,000
1986-2086 Average Annual				3,631,000			16,551,000	20,182,000

[1/]These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-20

RECREATION SUMMARY FOR THE EQ PLAN

Year	User Days Supplied: Big Game	Small Game	Waterfowl	Total Value ($)	Recreation Development[1/] Annual Visitations: General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	86,800	63,800	2,000	4,670,000	705,500	549,800	17,273,000	21,943,000
1996	87,500	64,300	2,000	4,707,000	705,500	549,800	17,273,000	21,980,000
2006	87,800	64,200	2,000	4,718,000	705,500	549,800	17,273,000	21,991,000
2016	88,400	64,300	2,000	4,744,000	705,500	549,800	17,273,000	22,017,000
2026	88,900	64,200	2,000	4,763,000	705,500	549,800	17,273,000	22,036,000
2036	89,200	64,300	2,000	4,777,000	705,500	549,800	17,273,000	22,050,000
2086	89,200	64,300	2,000	4,777,000	705,500	549,800	17,273,000	22,050,000
1986-2086 Average Annual				4,708,000			17,273,000	21,981,000

[1/]These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-21

RECREATION SUMMARY FOR THE TS PLAN

Year	User Days Supplied				Recreation Development[1/] Annual Visitations			
	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	86,800	63,800	2,000	4,670,000	705,500	549,800	17,273,000	21,943,000
1996	87,500	64,400	2,000	4,709,000	705,500	549,800	17,273,000	21,982,000
2006	87,900	64,200	2,000	4,722,000	705,500	549,800	17,273,000	21,995,000
2016	88,500	64,300	2,000	4,748,000	705,500	549,800	17,273,000	22,021,000
2026	89,200	64,400	2,000	4,778,000	705,500	549,800	17,273,000	22,051,000
2036	89,500	64,500	2,000	4,792,000	705,500	549,800	17,273,000	22,065,000
2086	89,500	64,500	2,000	4,792,000	705,500	549,800	17,273,000	22,065,000
1986-2086 Average Annual				4,710,000			17,273,000	21,983,000

[1/] These visitations are above the existing level of general recreation and fishing visitations.

TABLE D-2-22

RECREATION SUMMARY FOR THE RECOMMENDED PLAN

	User Days Supplied				Recreation Development[1] Annual Visitations			
Year	Big Game	Small Game	Waterfowl	Total Value ($)	General Recreation	Fishing	Total Value ($)	Grand Total ($)
1986	96,400	65,900	2,100	5,098,000	705,500	320,100	16,551,000	21,649,000
1996	97,200	66,500	2,100	5,141,000	705,500	320,100	16,551,000	21,692,000
2006	97,500	66,300	2,000	5,147,000	705,500	320,100	16,551,000	21,698,000
2016	98,100	66,400	2,000	5,173,000	705,500	320,100	16,551,000	21,724,000
2026	98,800	66,500	2,000	5,203,000	705,500	320,100	16,551,000	21,754,000
2036	99,100	66,600	2,100	5,220,000	705,500	320,100	16,551,000	21,771,000
2086	99,100	66,600	2,100	5,220,000	705,500	320,100	16,551,000	21,771,000
1986-2086 Average Annual				5,141,000			16,551,000	21,692,000

[1] These visitations are above the existing level of general recreation and fishing visitations.

COMMERCIAL FISHING

D.2.45. General. The NED benefits to commercial fishing attributable to project alternatives are defined as the incremental effects of those alternatives on the income of harvesters of fish (fishermen). For purposes of estimating these impacts for this report, certain modifications were made to the study, "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin," F. Bell, 1981. This report served as the major source of information for the calculation of commercial fishing benefits. Modifications to the results are described subsequently. The purpose of these adjustments was to present the findings of the study in a format that would be compatible with the Water Resources Council (WRC) publication, "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C); Final Rule," hereafter referred to as WRC procedures.

D.2.46. Budget Adjustments. As described in the summary of the Bell study of commercial fishing and trapping (Section 6 of this appendix), a major task in that study was the development of a budget for the representative fishermen in the Atchafalaya Basin. To make this budget compatible with the WRC procedures, it was necessary to make certain adjustments to the Bell budget as shown in Table D-2-23.

D.2.47. Clarification of the data presented in Table D-2-23 requires the inclusion of the following:

- The Bell budget was based on Bell's Table 6.4, Estimated Earnings and Cost, Crawfish and Finfish Fishermen (simulated full-time).

- The WRC procedures require that a management fee equal to 10 percent of the variable costs be included in the budget.

- Bell's depreciation charge hinged on the assumption that the fisherman's capital equipment (truck, boat, and trailer) was used exclusively for business purposes. A more appropriate assumption would be that these items would actually be used 50 percent for business and 50 percent for personal use, hence the reduction in the depreciation charged.

- The insurance charge was deleted in the adjusted budget since it should be attributed to personal and not to business use.

- The WRC procedures require that a capital charge equal to the dollar value of the capital employed in the enterprise times the project interest rate be assigned to the budget. Only that portion of the capital equipment actually utilized in the business would be used to calculate this charge as was the case with depreciation.

TABLE D-2-23

ESTIMATED REVENUE AND COSTS OF FULL-TIME FISHERMEN

Item	Bell Budget	Adjusted Budget
	($)	($)
Revenue	28,190	28,190
Variable Cost	14,520	14,520
Management Fee	-	1,452
Depreciation	3,100	1,550
Insurance	100	-
Cost of Capital	1,905	484
Wages	-	7,373
Total Costs	19,625	25,379
Profit	8,565	2,811
Profit Rate	Not Applicable	10 Percent

- Wages are a cost of the business enterprise and must be included in the budget according to the WRC procedures. The opportunity cost of labor was assumed to be \$3.20/hour, the typical wage for agricultural labor in Atchafalaya Parishes. It was further assumed that the fisherman invests 8 hours per day for 288 days in his fishing operation.

- Bell's profit figure is actually the net return to capital, labor, and management. Although the fisherman receives all three forms of income in a cash-flow sense, this figure as calculated by Bell is not profit as defined in the WRC procedures.

- The profit rate as measured here is useful in determining plan benefits, i.e., the benefit of any alternative would be equal to the incremental revenue times 0.10. This profit rate is not what economists generally refer to as a profit rate, since the usual meaning of such a term is the percentage return on invested capital (rate of return on equity capital.)

D.2.48. Maximum Sustainable Yield. In his study, Bell used a bio-economic model of the fisheries to estimate the maximum sustainable yield (MSY) of the principal basin species. Because the value of the crawfish harvest was 78 percent of the total value of all commercial fish harvested in the basin over the period 1976-1979, (Table D-2-24), and because the modeling results with crawfish were significantly more successful than with the other species, Bell used the crawfish harvest to estimate all the commercial fishing benefits. The multiplier used to expand the crawfish revenue into total commercial fishing revenue was 1.28 (or the inverse of 0.78).

D.2.49. Since crawfish were the key to estimating the commercial fishing benefits, the MSY of crawfish became an important input to the benefit evaluation. Bell has estimated, using the National Marine Fisheries (NMF) data, that the current MSY for crawfish is 16 million pounds, as described in the summary of the Bell study (Section 6 of this appendix). Bell also used the "Atchafalaya Basin Usage Study" (Usage Study) as a data source. According to the Usage Study, the landings of commercial fish were considerably in excess of the numbers generated by the NMF survey. To account for these differences, it was decided to inflate the crawfish MSY by 2.67, which was the weighted multiplier for adjusting the NMF data to the Usage Study. Thus, the current MSY (high estimate) became 43 million pounds of crawfish annually. When the value of this harvest was then multiplied by 1.28, the resultant was Bell's estimate of the total revenue of the commercial fish harvest in the basin.

D.2.50. Bell's estimated crawfish MSY of 43 million pounds was calculated for current (1980) conditions. The physical processes of continued channel enlargement of the Atchafalaya River and sediment

TABLE D-2-24

POUNDS AND VALUE OF FISH AND SHELLFISH FOR THE ATCHAFALAYA BASIN 1/

Species	1976 Pounds	1976 Value ($)	1977 Pounds	1977 Value ($)	1978 Pounds	1978 Value ($)	1979 2/ Pounds	1979 2/ Value ($)
Bowfin	13,200	945	11,500	1,014	3,700	356	13,600	1,406
Buffalo	726,900	108,587	836,200	129,733	1,365,700	231,959	2,055,400	353,113
Carp	105,100	4,272	59,800	2,959	61,500	3,235	131,800	10,128
Catfish	644,600	225,585	631,900	228,216	660,400	270,170	613,600	255,509
Garfish	75,900	11,029	93,700	15,996	130,500	25,375	158,500	34,280
Paddlefish	3,100	249	2,700	254	14,900	1,759	30,600	3,349
Gou	354,300	52,582	345,500	52,448	203,900	32,307	527,600	87,068
Shad	573,100	21,735	654,600	31,039	413,100	25,644	474,100	48,343
Crawfish	5,620,100	1,692,063	1,310,900	708,413	13,941,700	4,107,092	5,524,500	1,981,940
Freshwater Turtle	9,100	4,013	6,900	3,247	13,400	5,016	29,900	16,249
Frog	25,000	19,075	21,000	19,969	33,500	47,492	15,400	15,166
River Shrimp	2,500	1,750	2,000	1,392	4,800	3,663	8,500	6,376
Total	8,152,900	2,141,885	3,976,700	1,194,680	16,847,100	4,754,068	9,583,500	2,812,927

1/ National Marine Fisheries Service as cited in "Commerical Fishing and Trapping: An Economic Analysis of the Atchafalya Basin", F.W. Bell, 1981.
2/ Preliminary, subject to revision

deposition in the flooded overbank areas are responsible for the drying-out process presently underway in the lower floodway. This drying-out process is associated with the loss of fisheries-supporting habitat and, over time, would be responsible for reductions in the current MSY level. Table D-2-25 presents the estimated levels of MSY for each plan alternative, as well as for the future without-project condition using Bell's estimate as a starting point. As can be seen, the MSY would decrease under all conditions. This reduction would be greatest with the NED plan, which has the lowest flowline and the most accentuated drying-out effects. The EQ, TS, and recommended plans, while showing a decline, would not result in as great a reduction as the NED plan or future without-project condition due to the habitat-preserving features that they include. These features include the real estate easements that would prevent development and conversion of forestland to cropland, as well as the construction of management units that would regulate water levels to the benefit of the fish and wildlife resources.

D.2.51. Computation of Benefits. Bell estimated a growth of demand for crawfish that indicated that the current MSY would be reached in year 1994. After that, prices (real price of crawfish) would continue to rise with quantity supplied fixed at 16 million pounds (or 43 million pounds using the higher usage study data). The benefit to any alternative would be the net income associated with the difference between that project alternative's MSY and the MSY of the future without-project condition after 1992. The MSY becomes the constraint after 1992, because Bell's research indicated that demand for crawfish would exceed the estimated MSY's for all conditions by 1992. In effect, what he found was that demand would be sufficient to clear the market of all crawfish supplied. Thus, any project alternative that lowers the MSY below that of the future without-project condition would have a negative commercial fishing benefit. For purposes of quantifying the benefits, the differences in revenue between each alternative and the future without-project condition were derived from the Bell data. This revenue difference was then multiplied by the net income factor of 10 percent (see paragraph on budget adjustments). The resultant figure was then multiplied by 1.28 to get the net income for the entire fisheries.

D.2.52. Summary. Table D-2-26 presents the estimated net income figures for each plan alternative and the future without-project condition. The NED plan would result in only a moderate reduction, approximately 6 percent, in the average annual net income it would generate when compared to the future without-project condition. However, when compared to the EQ, TS, or recommended plans the reduction would be more significant, approximately 15 percent. This reduction was limited to only 15 percent because until 1992, MSY for all conditions would exceed the level of demand, and despite a greater decline in MSY for the NED versus the future without-project condition, there would be no difference in net income between plans.

TABLE D-2-25

MAXIMUM SUSTAINABLE YIELDS
(MILLIONS OF POUNDS)

Year	Future Without-Project	Plan			
		NED	EQ	TS	Recommended
1986	43.00	43.00	42.22	42.22	42.22
1996	37.14	35.76	39.35	39.32	39.32
2006	32.40	30.38	36.87	36.85	36.85
2016	28.79	25.74	34.35	34.34	34.34
2026	26.73	23.01	31.61	31.61	31.61
2036	26.11	22.24	30.60	30.58	30.58
2086	26.11	22.24	30.60	30.58	30.58

TABLE D-2-26

SUMMARY OF COMMERCIAL FISHING NET INCOME

Year	Future Without-Project	NED	EQ	TS	Recommended
	($)	($)	($)	($)	($)
1986	2,800,000	2,800,000	2,800,000	2,800,000	2,800,000
1996	5,470,000	5,200,000	5,800,000	5,790,000	5,790,000
2006	7,300,000	6,860,000	8,310,000	8,310,000	8,310,000
2016	8,690,000	7,770,000	10,380,000	10,370,000	10,370,000
2026	10,160,000	8,740,000	12,020,000	12,020,000	12,020,000
2036	10,730,000	9,140,000	12,570,000	12,570,000	12,570,000
2086	10,730,000	9,140,000	12,570,000	12,570,000	12,570,000
1986-2086 Average Annual	5,820,000	5,460,000	6,400,000	6,400,000	6,400,000

D.2.53. Net income for all conditions is projected to increase over time despite a projected decrease in fisheries-supporting habitat and a resulting decline in MSY. These increases in net income would occur as a result of the continually increasing real price of crawfish (an increase in the relative price of crawfish versus other commodities).

COMMERCIAL TRAPPING

D.2.54. General. Commercial trapping is a relatively small industry in the Atchafalaya Basin and in recent years has accounted for less that 5 percent of the total value of the commercial catch of fish and fur bearing animals (Table D-2-27). Commercial trapping is, however, for some fishermen, an important adjunct activity that they pursue for a few months of the year. As with commercial fishing, a few species dominate the fur-harvesting industry. In the basin, nutria, raccoon, and mink collectively accounted for more than 96 percent of the value of trapping in the period 1971-74 (Table D-2-28). Recent estimates of the fur-bearing harvest in the basin placed the value of the catch at approximately $300,000 to $400,000 (Table D-2-29). Louisiana's output of furs has little or no effect on the price of pelts since the total output of the state is miniscule relative to world supply. For purposes of the analysis, this condition was assumed to prevail throughout the period of analysis, and the real price of pelts was assumed to remain unchanged.

D.2.55. Budget Adjustments. As described in the summary of the Bell study of commercial fishing and trapping (see Section 6 of this appendix), a major task of that study was the development of a budget for the representative trapper in the Atchafalaya Basin. As with the budget that Bell developed for the representative fisherman, it was necessary to make adjustments to the trapper's budget in order to make it compatible with the WRC procedures. These adjustments are shown in Table D-2-30. Clarification of the data presented in Table D-2-30 requires the inclusion of the following:

- The Bell budget was based on the 1978-1979 budget presented in the Bell report.

- The WRC procedures require that a management fee equal to 10 percent of the variable costs be included in the budget.

- Bell did not include a depreciation charge in his trapping budget. Since commercial trappers, typically, are also commercial fishermen and since they ordinarily own the same equipment, i.e., boat, trailer, etc., it was assumed that this

TABLE D-2-27

COMPARISON OF THE ECONOMIC IMPORTANCE OF COMMERCIAL FISHING AND TRAPPING IN THE ATCHAFALAYA RIVER BASIN[1/]

Year	Commercial Fishing	Commercial Trapping	Total	Percent Trapping of Total
	($)	($)	($)	($)
1971-72 [2/]	4,641,000	82,000	4,723,000	1.7
1972-73 [3/]	9,632,000	233,000	9,865,000	2.4
1973-74 [3/]	4,536,000	199,000	4,735,000	4.4

[1/] Atchafalaya Basin Usage Study (1975) as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.
[2/] Represents grand totals or day and night combined.
[3/] Only day totals reported.

TABLE D-2-28

COMMERCIAL FUR CATCH IN THE ATCHAFALAYA RIVER BASIN [1/]
(In Thousands)

Species	1971-72		1972-73		1973-74	
	Number[2/]	Value	Number[2/]	Value	Number[2/]	Value
		($)		($)		($)
Nutria	9	24	42	136	30	119
Raccoon	9	30	10	57	9	61
Mink	3	14	6	37	2	13
Muscrat	0	0	1	3	1	1
Beaver	3/	1	0	0	0	0
Opposum	0	0	0	0	3/	2
Other	0	0	0	0	3/	4
Total		69		233		199

1/ Atchafalaya Basin Usage Study (1975) as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.
2/ Day totals only.
3/ Less than 0.5.

TABLE D-2-29

ESTIMATED GROSS RECEIPTS FROM TRAPPING IN THE ATCHAFALAYA RIVER BASIN[1/]

Species	Louisiana		Atchafalaya Basin [2/]	
	Number	Value($)	Number	Value($)
		1977-78		
Nutria	1,714,083	8,263,373	25,711	123,950
Raccoon	192,845	1,967,022	14,463	147,527
Mink	28,101	252,909	2,950	26,555
Total		10,483,304		298,032
		1978-79		
Nutria	1,145,084	4,823,094	17,176	72,421
Raccoon	231,747	3,383,507	17,381	253,763
Mink	51,731	465,579	5,432	48,886
Total		8,672,180		375,070

[1/] Louisiana Department of Wildlife and Fisheries as cited in "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya Basin," F.W. Bell, 1981.

[2/] Nutria 1.5 percent of state.
Racoon 7.5 percent of state.
Mink 10.5 percent of state.

TABLE D-2-30

ESTIMATED REVENUE AND COST OF THE AVERAGE
ATCHAFALAYA RIVER BASIN TRAPPER

Item	Bell Budget	Adjusted Budget
Revenue	3,639	3,639
Variable Cost	875	875
Management Fee	-	88
Depreciation	-	388
Insurance	-	-
Cost of Capital	-	121
Wages	-	1,536
Total Costs	875	3,008
Profit	2,764	631
Profit Rate	Not Applicable	17 Percent

same equipment was used in the commercial trapping operation. Since commercial trapping is approximately a 3-month activity, the calculation of depreciation was \$3,100 multiplied by 1/2 by 1/4 = \$388, where \$3,100 equaled the depreciation in the Bell budget (commercial fishing). One-half was the correction factor to adjust for the equipment being utilized 50 percent for business, and one-fourth represents the portion of the year that the equipment was utilized for commercial trapping.

• The WRC procedures require that a capital charge equal to the dollar value of the capital employed in the enterprise times the project interest rate be assigned to the budget. Only that portion of the capital equipment actually utilized in the business would be used to calculate this charge, as was the case with depreciation.

• Wages are a cost of the business enterprise and must be included in the budget according to the WRC procedures. The opportunity cost of labor in this instance was assumed to be \$3.20/hour (same as commercial fishing). The amount of labor time invested in the operation was assumed to be 60 days times 8 hours per day for a total of 480 hours.

• Bell's profit figure is actually the net return to capital, labor, and management. Although the trapper receives all three forms of income in a cash flow sense, this figure as calculated by Bell is not profit as defined in the WRC procedures.

• The profit rate as measured here is a useful method in determining plan benefits, i.e., the benefit of any alternative would be equal to the incremental revenue times 0.17. This profit rate is not what economists generally refer to as a profit rate, since the usual meaning of such a term is the percentage of return on invested capital (rate of return on equity capital).

D.2.56. Computation of Benefits. The NED commercial trapping benefits were measured as the incremental net income to the trapper, comparing the future without-project condition to the various plan alternatives. In the preceding paragraph on budget adjustments, it was determined that net income to the trapper is on the average approximately 17 percent of total revenue. To estimate NED benefits, it was then necessary to develop a method for estimating catch levels and the corresponding total revenue.

D.2.57. As was the case in all previous benefit estimations, the projection of land use (habitat types) was essential. This also was true for commercial trapping. Given the biological carrying capacities for each habitat type for each of the three major species, it was possible to estimate a population size for a specific point in

time based on the land use. Therefore, using the land-use projections, population sizes for each of the major species were estimated over the project life. The next step was to estimate catch, having previously estimated the population. This was accomplished by multiplying the estimated population size by the ratio of the 1979 actual catch to the estimated 1979 population size. This catch-population relationship was assumed to remain constant for the project life. The estimated catch was multiplied by the 1976-80 average price to compute total revenue.

D.2.58. Having determined biological carrying capacities by habitat type, future land use, a catch-population relationship, and a representative price, the total revenue was estimated for each project alternative and the future without-project condition for specified points in time. An example of total revenue computation for the future without-project condition for 1986 is presented in Tables D-2-31 through D-2-33. These tables show the total revenue computation for mink, nutria, and racoon, respectively. The computation for the various plan alternatives was the same except that the habitat types associated with each plan alternative changed over time at different rates.

D.2.59. Summary. The procedure described in the preceding paragraph was used to generate a stream of total revenue figures associated with each plan alternative and the future without-project condition. The stream of total revenue for each condition was converted to net income to the fisherman by multiplying total revenue by the profit rate, 0.17.

D.2.60. These net income figures, as well as average annual values, are presented in Table D-2-34. It can be seen that the EQ, TS, and recommended plans effectively maintain the existing level of net income during the project life while the future without-project condition and the NED plan show a drop of approximately 30 percent in net income during the first 50 years of the project life. However, when viewed in terms of absolute amounts, the decrease in net income associated with these two conditions is not significant.

TABLE D-2-31

ESTIMATED MINK POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.05	73,800	3,690
LSBLHW	0.05	253,000	12,650
CT	0.10	173,000	17,300
MIX	0.10	10,400	1,040
CU	0.05	6,400	320
OPEN	0.00	23,500	0
Total Estimated 1986 Population			35,000
			x 0.153 2/
Estimated 1986 Catch			5,355
1976-80 Average Price			x $9.70
Total Revenue			$51,900

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-32

ESTIMATED NUTRIA POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.00	73,800	0
LSBLHW	0.00	253,000	0
CT	0.50	173,000	86,500
MIX	0.50	10,400	5,200
CU	0.00	6,400	0
OPEN	0.00	23,500	0
Total Estimated 1986 Population			91,700
			x 0.186 2/
Estimated 1986 Catch			17,056
1976-80 Average Price			x $5.71
Total Revenue			$97,400

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-33

ESTIMATED RACOON POPULATION, CATCH, AND REVENUE
FUTURE WITHOUT-PROJECT CONDITION

Habitat Type 1/	Carrying Capacity	1986 Acres	1986 Population
ESBLHW	0.066	73,800	4,920
LSBLHW	0.066	253,000	16,867
CT	0.066	173,000	11,533
MIX	0.066	10,400	693
CU	0.066	6,400	427
OPEN	0.000	23,500	0
Total Estimated 1986 Population			34,440
			x 0.498 2/
Estimated 1986 Catch			17,151
1976-80 Average Price			x $10.98
Total Revenue			$188,300

1/ ESBLHW - early successional bottomland hardwoods.
LSBLHW - late successional bottomland hardwoods.
CT - cypress-tupelo.
MIX - early successional bottomland hardwoods/cypress-tupelo.
CU - compostion unknown,.
OPEN - cleared land/levees, etc.

2/ Ratio of the 1979 actual catch to the 1979 estimated population.

TABLE D-2-34

SUMMARY OF COMMERCIAL TRAPPING NET INCOME

Year	Future Without-Project	Plan NED	Plan EQ	Plan TS	Plan Recommended
	($)	($)	($)	($)	($)
1986	57,000	57,000	58,000	58,000	58,000
1996	54,000	54,000	57,000	57,000	57,000
2006	49,000	48,000	57,000	57,000	57,000
2016	45,000	43,000	57,000	57,000	57,000
2026	43,000	41,000	57,000	57,000	57,000
2036	42,000	40,000	57,000	57,000	57,000
2086	42,000	40,000	57,000	57,000	57,000
1986-2086 Average Annual	52,000	52,000	57,000	57,000	57,000

Section 3 - SUMMARY OF COSTS, BENEFITS, AND BENEFIT-COST RATIOS

GENERAL

D.3.1. Table D-3-1 presents a summary of the nonflood control average annual benefits for the Lower Atchafalaya Basin Floodway. Table D-3-2 presents a summary of both flood control and nonflood control first costs, while Table D-3-3 presents this cost breakdown in average annual terms. Table D-3-4 displays the nonflood benefit-cost ratios for each plan alternative.

D.3.2. It should be noted that interest during construction has been computed and included in the nonflood control first costs. Interest during construction however, was not computed for the flood control first costs. The purpose of including interest during construction is to adjust total costs and the resulting annual costs to reflect that the projected benefit stream and the expenditure of construction costs do not necessarily begin simultaneously. This calibration of expenditure and benefit flows (accomplished here by interest during construction) is required for benefit-cost evaluation. As previously discussed, the flood control features of this plan represent integral parts of the ongoing comprehensive MR&T project. As such, these features are not subject to incremental economic evaluation. Because incremental economic evaluation is not required, and the benefit stream of the MR&T project has been ongoing for many years, interest during construction was not computed for the flood control costs.

TABLE D-3-1

SUMMARY OF AVERAGE ANNUAL NONFLOOD CONTROL BENEFITS
(In Thousands)

Category	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Agriculture	1/	2/	2/	2/
Timber	3/	65	66	30
Recreation				
Hunting	4/	1,060	1,062	1,493
Recreation Development	16,551	17,273	17,273	16,551
Commercial Fishing	5/	580	580	580
Commercial Trapping	6/	5	5	5
Total	16,551	18,983	18,986	18,659

1/ Annual gain of $139,000 is a result of flood control features.
2/ Annual loss of $2,604,000 is a result of nonflood control features. The cost of this foregone income is reflected in the nonflood control easement costs.
3/ Annual loss of $26,000 is a result of flood control features.
4/ Annual loss of $17,000 is a result of flood control features.
5/ Annual loss of $360,000 is a result of flood control features.
6/ No incremental impact versus the future without-condition.

TABLE D-3-2

FIRST COSTS
(In Thousands)

Item[1/]	Plan NED	EQ	TS	Recommended
	($)	($)	($)	($)
Flood Control				
Construction Necessitated by Flowline Changes[2/]	576,620	588,981	551,631	551,631
Channel Training Above Morgan City	52,450	52,450	52,450	52,450
Sediment Control	31,100	31,100	31,100	31,100
Outlet Control	20,000	10,830	10,830	10,830
Widen Wax Lake Outlet Overbank	90,500	90,500	90,500	90,500
Channel Training Below Morgan City	11,650	-	11,650	11,650
Avoca Island Levee Extension	56,212[3/]	-	-	-
Simple Flowage Easements	32,149	21,510	21,510	19,732
Mitigation	46,844[4/]	-	-	-
Total Flood Control	917,525	795,371	769,671	767,893
Nonflood Control				
Recreation Development	20,356[5/]	20,043[6/]	20,043[6/]	20,043[6/]
Management Units[7/]	-	23,730	23,730	23,730
Freshwater Structures	-	8,109	8,109	8,109
Increase Sediment Through Wax Lake Outlet	-	21,300	-	-
Environmental Easements	-	114,866	114,866	100,538
Public Access Easements[8/]	-	31,422	31,422	66,693
Canal Closures and Circulation Improvements	-	1,000	1,000	1,000
Sub Total	20,356	220,470	199,170	220,113
Interest During Construction[9/]	1,552	16,811	15,187	16,784
Total	21,908	237,281	214,357	236,897
Total Project	939,433	1,032,652	984,028	1,004,790

1/ Each construction (non-easement) item includes 25 percent for contingencies, 8 percent for supervision and administration, and 8 percent for engineering and design, except for Recreation Development which includes 25 percent contingencies, 13 percent supervision and administration, and 12 percent engineering and design. Easement items include 25 percent for contingencies plus acquisition and resettlement costs.

2/ Includes changes to levees and floodwalls, locks, etc.

3/ Represents construction cost for first reach only. Total cost for full extension of channel alinement is $271,680,000.

4/ Includes costs for mitigation of only first reach of Avoca Island Levee Extension. Total mitigation requirements with full extension are $131,844,000.

5/ Includes $1,187,000 for fee acquisition of 1,500 acres required for construction of facilities.

6/ Includes $874,000 for fee acquisition of 1,500 acres required for construction. This cost for fee acquisition is less than the cost of fee acquisition associated with the NED plan because fee acquisition is accomplished assuming basin-wide comprehensive easements are in place. This reduces the incremental cost of fee acquisition to $874,000.

7/ Includes construction costs only. Required flowage easements are included in Environmental Easements.

8/ Does not include cost for fee acquisition of 1,500 required for recreation development. This cost is included in Recreation Development.

9/ Assumes construction period of two years.

TABLE D-3-3

ANNUAL COSTS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Flood Control				
Interest and Amortization	70,007	60,687	58,726	58,590
Operation and Maintenance	14,673	14,439	15,606	15,606
Total	84,680[1/]	75,126	74,332	74,196
Nonflood Control				
Interest and Amortization	1,672	18,105	16,355	18,075
Operation and Maintenance	383	433	433	433
Total	2,055	18,538	16,788	18,508
Total Project	86,735[1/]	93,664	91,120	92,704

[1/] With full extension of the Avoca Island Levee total annual flood control costs would be $107,606,000 and total project annual costs would be $109,661,000.

TABLE D-3-4

NONFLOOD CONTROL BENEFIT-COST RATIOS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Average Annual Benefits	16,551	18,983	18,986	18,659
Average Annual Costs	2,055	18,538	16,788	18,508
Net Benefits	14,496	445	2,198	151
Benefit-Cost Ratio	8.1 to 1	1.02 to 1	1.13 to 1	1.01 to 1

Section 4 - INCREMENTAL EVALUATION — RECREATION DEVELOPMENT PLAN

OVERALL VERSUS INCREMENTAL EVALUATION

D.4.1. The importance of the recreation development plan to the overall evaluation of nonflood features is presented in Table D-4-1. The annual benefits generated by the recreation development plan represented approximately 90 percent of the total annual nonflood control benefits of the EQ, TS, and recommended plans, and in the case of the NED plan, they represented 100 percent of the total.

TABLE D-4-1

RECREATION DEVELOPMENT BENEFITS AS A PERCENT OF
TOTAL NONFLOOD CONTROL BENEFITS
(In Thousands)

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Total Annual Nonflood Control Benefits	16,551	18,983	18,986	18,659
Annual Recreation Development Benefits	16,551	17,273	17,273	16,551
Recreation Development as a Percent of Total	100	91	91	89

D.4.2. The fact that the recreation development plan accounted for such an overwhelming percentage of total benefits suggests that this feature should be considered as a separable feature and evaluated incrementally. (In the case of the NED plan, the evaluation of nonflood control features has produced an incremental evaluation of the recreation development plan. This is because recreation development represents the only nonflood control feature of the NED plan.) In addition to accounting for approximately 90 percent of total benefits, the fact that these benefits could be achieved by

construction of only those features associated with the development plan adds significantly to the case for incremental evaluation. Fee purchase of approximately 1,500 acres and construction of facilities on these acres would be the only requirements for the plan to be effective. Purchase of additional real estate easements to provide public access or to preserve fish and wildlife habitat would not be necessary for the development plan to achieve the stated level of benefits.

D.4.3. Identification of separable features usually involves considerable judgment. The extent to which project features are separable and require incremental evaluation must be made on a case-by-case basis. The ability to fully allocate costs in a nonarbitrary manner along with the ability to independently achieve stated output levels are important factors in making this determination. In the present case, a supportable defense could be made for incremental evaluation of the recreation development plan as a separable feature.

D.4.4. Table D-4-2 presents an incremental evaluation of the recreation development plan assuming all other nonflood control features are in place. As was suggested by the high percentage of total benefits that the development plan represented, the incremental evaluation produced a highly favorable economic justification. (It should be noted that the 1,500 acres required for construction of the recreation development facilities would result in some very minor losses to timber and recreational hunting. For purpose of incremental analysis, this would slightly increase the cost of the development plan.) Table D-4-3 presents an evaluation of the remaining nonflood control features exclusive of the development plan. With annual benefits approximately 90 percent less, while still carrying the majority of the annual costs (approximately 89, 88, and 89 percent, respectively, for the EQ, TS, and recommended plans), the remaining nonflood control features lacked tangible economic justification.

D.4.5. Inclusion of the recreation development facilities in the overall evaluation of nonflood control features results in an economically justified plan in tangible economic terms. When they are included, the EQ, TS, and recommended plans yield benefit-cost ratios of 1.02 to 1, 1.13 to 1, and 1.01 to 1, respectively (see Table D-3-4). In their absence, the EQ, TS, and recommended plans fall to 0.10 to 1, 0.12 to 1, and 0.13 to 1, respectively. These other nonflood control features, however, have been included in the Recommended plan because of the significant contribution that they make to the environmental quality account. While providing only limited tangible economic benefits, these features are considered to be justified on the basis of their intangible benefits and their contributions to the study goal of environmental protection.

TABLE D-4-2

INCREMENTAL EVALUATION OF RECREATION DEVELOPMENT

Item	Plan			
	NED	EQ	TS	Recommended
	($)	($)	($)	($)
Annual Benefits				
General Recreation	5,235,000	5,235,000	5,235,000	5,235,000
Fishing	11,316,000	12,038,000	12,038,000	11,316,000
Total	16,551,000	17,273,000	17,273,000	16,551,000
Annual Costs				
Interest and Amortization	1,672,000	1,646,000	1,646,000	1,646,000
Operation and Maintenance 1/	383,000	383,000	383,000	383,000
Total	2,055,000	2,029,000	2,029,000	2,029,000
Benefit-Cost Ratio	8.1 to 1	8.5 to 1	8.5 to 1	8.2 to 1

1/ Basis of O&M estimate is presented in Appendix F, Recreation Resources

TABLE D-4-3

EVALUATION OF NONFLOOD CONTROL FEATURES
VIEWED INCREMENTALLY OF RECREATION DEVELOPMENT

Item	Plan: EQ	Plan: TS	Plan: Recommended
	($)	($)	($)
Annual Benefits			
Agriculture	1/	1/	1/
Timber	65,000	66,000	30,000
Recreation	1,060,000 2/	1,062,000 2/	1,493,000 1/
Commercial Fishing	580,000	580,000	580,000
Commercial Trapping	5,000	5,000	5,000
Total	1,710,000	1,713,000	2,108,000
Annual Costs			
Interest and Amortization	16,459,000	14,709,000	16,429,000
Operation and Maintenance	50,000	50,000	50,000
Total	16,509,000	14,759,000	16,479,000
Benefit-Cost Ratio	0.10 to 1	0.12 to 1	0.13 to 1

1/ Annual loss of $2,604,000 is a result of nonflood control features. The cost of this foregone income is reflected in the nonflood control easement costs.

2/ Represents impacts other than those resulting from the recreation development plan.

Section 5 - LAND CLEARING PROJECTIONS

GENERAL

D.5.1. This section contains the background and basic assumptions used to project the conversion of bottomland hardwoods to agricultural production in the Lower Atchafalaya Basin Floodway.

BACKGROUND

D.5.2. The decline of bottomland hardwood forests in the lower Mississippi Valley has been reported in "Documentation, Chronology, and Future Projections of Bottomland Hardwood Habitat Loss in the Lower Mississippi Alluvial Plain," a contract study performed for the US Fish and Wildlife Service by HRB - Singer, Inc. That report, detailing the loss of bottomland hardwoods and other forestland in Louisiana, forms the basis for data shown in Tables D-5-1 and D-5-2. These tables show that hundreds of thousands of acres of bottomland hardwoods have been cleared in Louisiana over the last few decades and that the trend appears to be accelerating. Examination of the HRB - Singer, Inc., report indicates that the land clearing process eventually reaches a phase where the rate of clearing slows presumably because all of the acreage suitable for development is cleared. The basic assumptions in developing a land-clearing forecast for the Atchafalaya Basin are described subsequently. The overiding assumption, however, is that the owners of bottomland hardwood forests will continue to be motivated primarily by the expectations of profits. The trends described in the HRB - Singer, Inc., report will continue because the most valuable use of bottomland hardwood forests tends to be conversion to agricultural use, particularly soybeans. Land clearing on a large scale is a relatively new phenomenon in the basin but it is expected to result in the conversion of well over a hundred thousand acres in the next 50 years, which is not surprising when viewed from the record of what has happened in the lower Mississippi Valley during the past 50 years.

ASSUMPTIONS

D.5.3. The following paragraphs discuss the assumptions used in the land-clearing projections.

D.5.4. All privately owned land in the Lower Atchafalaya Basin Floodway, which is flood free three or more out of five years, between 1 June and 30 November, is subject to being cleared.

D.5.5. Land clearing will proceed from north to south as it has historically in the lower Mississippi Valley. The floodway was divided into three zones for purposes of projecting land clearing.

TABLE D-5-1

FOREST ACREAGE IN LOUISIANA

Parish	Total Bottomland Hardwoods		
	1957	1967	1977
Ascension	100,957	94,913	88,549
Assumption	148,420	137,348	128,515
Avoyelles	268,784	249,641	193,634
Caldwell	76,294	66,924	45,555
Catahoula	230,861	194,366	108,589
Concordia	321,538	246,243	158,232
East Carrol	90,180	60,607	42,191
Evangeline	15,910	13,540	11,777
Franklin	119,379	86,652	47,770
Grant	7,269	6,422	3,493
Iberia	88,087	86,504	83,818
Iberville	294,127	285,823	276,733
Jefferson	14,500	7,300	1,802
Lafayette	6,100	5,832	4,354
Lafourche	280,000	249,851	240,716
LaSalle	66,577	59,227	53,020
Madison	206,304	148,592	114,575
Morehouse	159,363	87,121	45,992
Orleans	12,200	8,000	0
Ouachita	97,821	90,060	79,854
Plaquemines	1,200	1,100	942
Pointe Coupee	200,742	176,113	144,424
Rapides	123,821	97,507	61,068
Richland	102,325	93,362	56,382
St. Charles	55,088	49,674	44,344
St. James	87,458	83,102	64,529
St. John the Baptist	72,300	70,782	69,209
St. Landry	243,014	225,395	190,289
St. Martin	337,200	321,402	305,800
St. Mary	54,560	41,388	33,083
Tensas	201,162	173,629	131,221
Terrebonne	77,837	52,088	43,055
Union	25,585	24,012	22,795
West Baton Rouge	73,664	71,018	58,717
West Carrol	29,524	27,168	15,105
West Feliciana	62,477	45,804	30,000
Total	4,352,628	3,738,510	3,000,132

TABLE D-5-2

FOREST ACREAGE
NET LOSS IN LOUISIANA

Parish	Total Bottomland Hardwoods 1957-1967	1967-1977
Ascension	6,044	6,364
Assumption	11,072	8,833
Avoyelles	19,143	56,007
Caldwell	9,370	21,369
Catahoula	36,495	85,777
Concordia	75,295	88,011
East Carrol	29,573	18,416
Evangeline	2,370	1,763
Franklin	32,727	38,882
Grant	847	2,929
Iberia	1,583	2,686
Iberville	8,304	9,090
Jefferson	7,200	5,498
Lafayette	268	1,478
LaFourche	30,149	9,135
LaSalle	7,350	6,207
Madison	57,712	34,017
Morehouse	72,242	41,129
Orleans	4,200	8,000
Ouachita	7,761	10,206
Plaquemines	100	158
Pointe Coupee	24,629	31,689
Rapides	26,314	36,439
Richland	8,963	36,980
St. Charles	5,414	5,330
St. James	4,356	18,573
St. John the Baptist	1,518	1,573
St. Landry	17,619	35,106
St. Martin	15,798	15,602
St. Mary	13,172	8,305
Tensas	27,533	42,408
Terrebonne	25,749	9,033
Union	1,573	1,217
West Baton Rouge	2,646	12,301
West Carrol	2,356	12,063
West Feliciana	16,673	15,804
Total	614,118	738,378

Zone 1 consists of Henderson Lake and Alabama Bayou, the two most northern management units. Zone 2 consists of all the other management units except Belle River and Sixmile Lake, which are in Zone 3.

D.5.6. A certain portion of the land that meets the flood-free condition will not be cleared for a variety of reasons. These reasons include limited access, poor drainage, small tracts, and general unsuitability for a profitable agricultural operation. It was assumed that in Zones 1 and 2, 80 percent of the flood-free land would ultimately be cleared. It was further assumed for reasons detailed subsequently that no land would be cleared in Zone 3.

D.5.7. Historically, land clearing, in an area starts slowly (learning phase), accelerates (development phase), and then tapers off (mature phase). This process is illustrated by Figure D-5-1.

D.5.8. For purposes of qualifying the impacts of the land-clearing process, the schedule of land clearing expected in the Atchafalaya Basin is presented in Table D-5-3.

D.5.9. For Zone 1, year 0 is assumed to be 1980, since the process of land clearing is already underway in the Henderson Lake area and, specifically, around Alabama Bayou. Since there is still a sizable amount of acreage yet to be cleared in the upper floodways and in Zone 1, it was assumed that year 0 would not occur in Zone 2 until 1995. To use Table D-5-3 to project land clearing, one must know the number of eligible acres and the zones. For instance, if there are 100,000 acres eligible for clearing in Zone 2 in 1995 (year 0), then it is expected that by 2010 (year 15) 40 percent, or 40,000 of these eligible acres, would be cleared.

TABLE D-5-3

PROJECTED SCHEDULE OF LAND CLEARING

Year	Percent of Eligible Acres Cleared	Incremental Percent Cleared
0-5	5	5
6-10	15	10
11-15	40	25
16-20	60	20
21-25	75	15
26-50	80	5

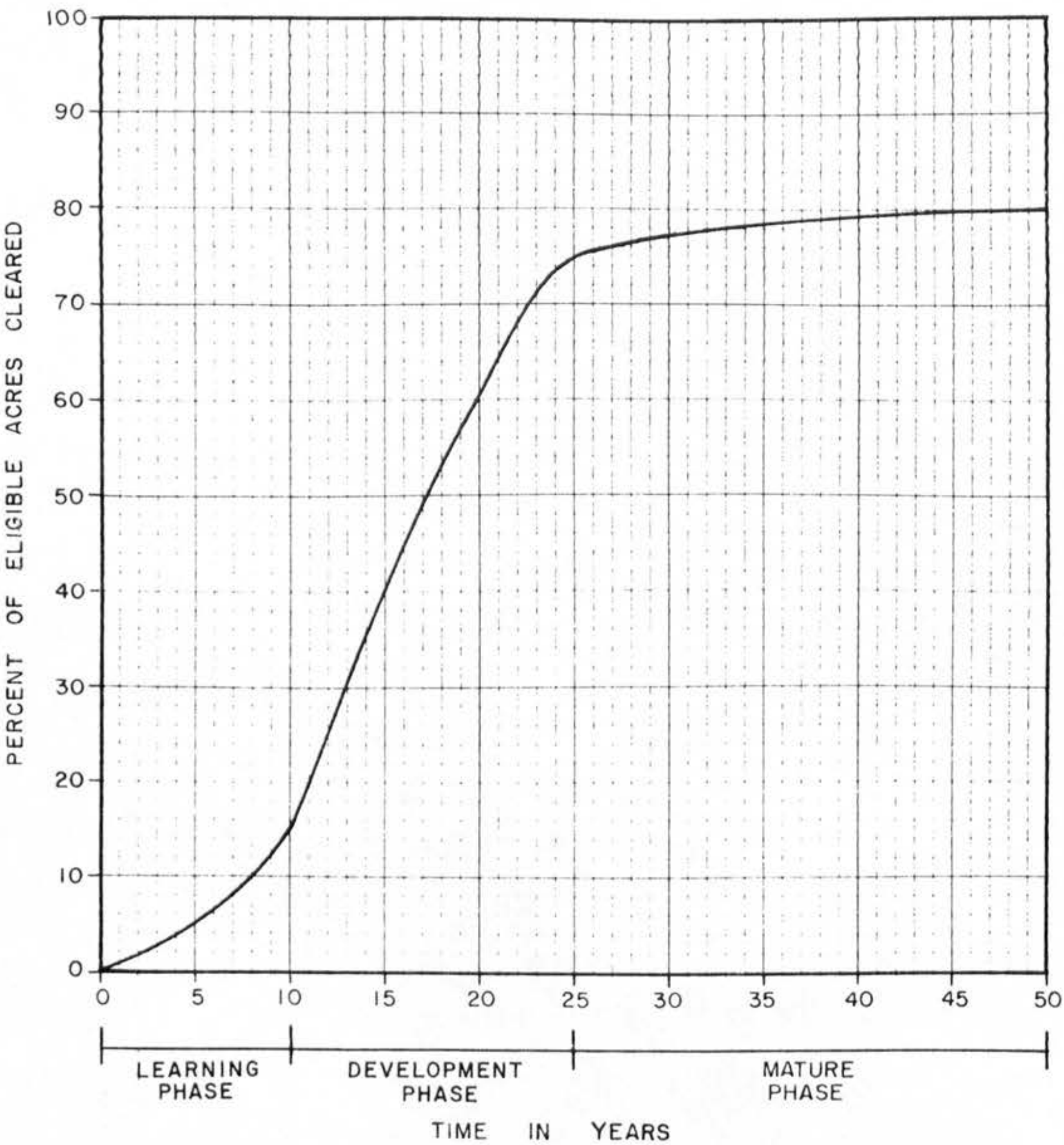

FIGURE D-5-1 CUMULATIVE LAND CLEARING CURVE

Section 6 - SUMMARY OF RELATED STUDIES

GENERAL

D.6.1. This section contains a summary of two studies conducted by Frederick W. Bell, Department of Economics, Florida State University. These two studies, "Recreational Benefits for the Atchafalaya River Basin," 1981, and "Commercial Fishing and Trapping: An Economic Analysis of the Atchafalaya River Basin," 1981, were the principal sources used in the NED benefit estimation process.

RECREATIONAL BENEFITS FOR THE ATCHAFALAYA RIVER BASIN

D.6.2. Background. This study, conducted under US Fish and Wildlife Service (USFWS) Control Number 14-16-009-80-009, was funded by the US Army Corps of Engineers, New Orleans District, and jointly administered by the Division of Program Plans, USFWS, and the New Orleans District. The purpose of the study was to develop from existing data the recreational activity values (user-day values) specific to the Atchafalaya Basin. This study was originally conceived, contracted, and initiated prior to the WRC procedures. Nevertheless, it was the objective of the project managers of the contracting agencies and Bell to develop procedures and estimates of recreational activity values (benefits) that would be fully consistent with the requirements of WRC procedures.

D.6.3. Tasks. Several tasks essential to the estimation of the recreational activity benefits were performed by Bell. These were:

- The development of methods and models to analyze data for purpose of estimating fish-and-wildlife-related recreational benefits in the Atchafalaya Basin Floodway.

- The integration, to the maximum extent possible, of all available data and the estimation (with this data base) of the widest possible array of fish-and-wildlife-related recreational activities.

- The calculation of the present value of each recreational activity benefit stream, including the projection of future demand/supply conditions for each type of recreational activity in the basin.

D.6.4. Data Sources. Two basic data sources, utilized by Bell in the course of the research were:

- "Atchafalaya Basin Usage Study," US Army Corps of Engineers, New Orleans District, 1975.

- US Fish and Wildlife Computer Tape, "1975 National Survey of Hunting, Fishing, and Wildlife Associated Recreation."

D.6.5. Methodologies and Models. The basic test that any recreational benefit estimation technique must meet to be compatible with recent WRC procedures is that the technique simulate, as closely as possible, the willingness of consumers to pay for increments of the recreational resource (lake, nature trail, boat ramp, or whatever the subject alternative might be). Two techniques described in detail in WRC procedures are the travel cost method (TCM) and the contingent valuation method (CVM). The data requirements of the TCM were not met by the available data. This was also the case with the CVM. Bell chose to estimate the recreational activity benefits through use of the hedonic valuation method. According to Bell:

> Recent developments in estimating the economic value of wildlife recreation has centered around the use of what is called the household production function by viewing the individual recreationist as both individual consumer and producer. In particular, the US Fish and Wildlife Service has extensively explored the use of the hedonic method in estimating wildlife benefits.
>
> Thus, the hedonic approach relies upon the demand for the characteristics of a good (e.g., three days of hunting deer with four kills-bag).

D.6.6. It should be noted that the end product of the hedonic valuation technique, as employed in Bell's study, is a demand curve (or schedule) for the recreational experience, e.g., a typical small game hunter would be willing to pay a certain amount of money for a given number of days of small game hunting of a given quality. Ideally, one quality variable would be the site itself, i.e., the Atchafalaya Basin. In this way, the researcher could evaluate the difference that a consumer would be willing to pay for a hunting day in the Atchafalaya Basin as opposed to a substitute site. Unfortunately, the "Atchafalaya Basin Usage Study" did not query recreationists about alternative sights outside the basin. To the extent that Bell's values capture willingness to pay for the experience even above willingness to pay for the site, then these values overstate the benefits of the recreational activity and should be viewed as an upper limit to recreational activity values. However, it should also be noted that many users and potential users of the Atchafalaya Basin have suggested that sites of similar quality are either nonexistent or are in very short supply. Evidence indicates that in future years this supply of alternative recreational sites (particularly for deer hunting) will shrink at a significant rate. Thus, it is not unreasonable to accept the proposition that in the Atchafalaya Basin, the demand for a recreational activity, such as deer hunting cannot be divorced from site. Simply stated, alternative

sites (of comparable quality) are extremely limited and for many users, even the alternative of a significantly lower quality site is limited.

D.6.7. User-Day Values. In his study, Bell reports several sets of hedonic valuation estimates and contrasts these valuation estimates with those generated by other methodologies and by other researchers. The diversity of values contained in these other studies (and in Bell's own work) is explained, at least in part, by the methodological differences themselves, the deficiencies in the various data bases, and the differences in geographical regions. In the Bell study, however, there is only one set of estimates that covers a wide enough array of activities to be useful in calculating recreational activity benefits for the Atchafalaya Basin study. These values in 1975 dollars are presented in Table D-6-1.

D.6.8. The values presented in Table D-6-1 were updated to 1981 dollars by using the US Department of Commerce Purchasing Power of the Dollar index as measured by consumer prices. These updated values are presented in Table D-6-2.

D.6.9. The Bell user-day values in 1981 dollars and the most recent Water Resources Council Principles and Standards (P&S) unit-day value ranges are presented in Table D-6-3 for purposes of comparison. It should be noted that the use of P&S values in this study is prohibited by WRC procedures which limit the use of the unit-day value method to studies involving less than 500,000 annual visits. Because the recreation development features of this study alone generate in excess of 1.2 million annual visits, the Bell estimates which represent the site-specific willingness to pay were used. Also worthy of note is the benefit-cost evaluation of the recreation development features allowing the P&S values. Although generally lower than the Bell values, the use of mid-range P&S values would generate annual benefits of sufficient amount to produce a benefit-to-cost ratio of 2.0 to 1 for the EQ and TS plans and 1.6 to 1 for the NED and recommended plans.

COMMERCIAL FISHING AND TRAPPING: AN ECONOMIC ANALYSIS OF THE ATCHAFALAYA RIVER BASIN

D.6.10. Background. This present study of the economics of the commercial fishing and trapping industry is, to the best of Bell's knowledge, the first study of its kind. Previous studies of the Atchafalaya Basin have focused on the culture, sociology, and folklore of the region but have not attempted to qualify, in a systematic way, the contributions of commercial fishing and trapping industries to the regional and national economy.

TABLE D-6-1

ATCHAFALAYA BASIN RECREATION VALUES
IN 1975 DOLLARS

Activity	Value Per Day ($)[1/]
Big Game Hunting	23.64
Small Game Hunting	9.79
Waterfowl Hunting	15.41
Bank Fishing	1.82
Boat Fishing	20.75
Permanent Camping	17.00
Other Nonconsumptive	4.30

[1/] Bell (1981) Table 2.20, except for Other Nonconsumptive, which is from Table 2.13.

TABLE D-6-2

ATCHAFALAYA BASIN RECREATION VALUES
IN 1981 DOLLARS

Activity	Value Per Day ($)
Big Game Hunting	40.78
Small Game Hunting	16.89
Waterfowl Hunting	26.58
Bank Fishing	3.14
Boat Fishing	35.79
Permanent Camping	29.33
Other Nonconsumptive	7.42

TABLE D-6-3

COMPARISON OF ATCHAFALAYA BASIN RECREATION VALUES

Activity	Value Per Day ($)	
	Bell	P&S
Big Game Hunting	40.78	10.50-17.90
Small Game Hunting	16.89	2.20-4.50
Waterfowl Hunting	26.58	2.20-4.50
Bank Fishing	3.14	2.20-4.50
Boat Fishing	35.79	2.20-4.50
Permanent Camping	29.33	1.50-4.50
Other Nonconsumptive	7.42	1.50-4.50

D.6.11. Tasks. Several tasks essential to the study were performed. These tasks were:

- The development of budgets for representative commercial fishermen and trappers in the basin

- The formulation of a bioeconomic model of the Atchafalaya Basin fisheries, which would be used to estimate the productivity of the fisheries, i.e., the ability to support and sustain a particular harvest (maximum sustainable yield or MSY)

- Estimation of demand curves for the products of the fishing and trapping industries

- The integration of the outputs derived from the above tasks to calculate the NED benefits of these industries

D.6.12. Data Sources. The two principal data sources utilized for this study were: "Atchafalaya Basin Usage Study," US Army Corps of Engineers, New Orleans District, 1975, and "Fishing Statistics of the United States, 1971-74," National Marine Fisheries, US Department of Commerce.

D.6.13. Methodology. The development of the budgets for commercial fishermen and trappers was accomplished by contacting key industry personnel in the Atchafalaya Basin region. Bell interviewed, by

telephone and in person, a representative sample of fishermen, processors, and marina operators to gather data for the budget estimates. Bell received significant support in construction of the commercial fishing budget from Dr. Ken Roberts, Fisheries Extension Economist, Louisiana State University, Center for Wetland Resources. For the commercial trapping industry, data sources were far more limited, and Bell's estimates of revenues and costs are based on limited contacts with fur processors and the sparse data that exists on this subject.

D.6.14. As for the estimation of maximum sustainable yield, Bell used procedures and modeling techniques that are standard in the fisheries economics literature. Historical data was used to estimate catch/effort relationships. Several alternative specifications of the catch/effort relationship were estimated and the reciprocal transformation yielded the best results for crawfish. Bell also attempted to ascertain the effects of water levels and temperatures on the crawfish harvest. These experiments yielded mixed results. The bioeconomic models for the principal Atchafalaya Basin species (crawfish, catfish and buffalo fish) were estimated, using data from the National Marine Fisheries series published by the US Department of Commerce. These data were also used to estimate the demand relationships for the principal species of fish.